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PHYSICAL TRAINING.

ILLUSTRATED.

H. R. SEYMOUR.

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BRITISH MEDICAL ASSOCIATION

PHYSICAL TRAINING:

Its Theory and Practice

BEING AN ELEMENTARY TREATISE ON THE NECESSITY AND EFFECTS OF EXERCISE.

A HANDBOOK FOR

TEACHER OR PUPIL, YOUNG OR OLD, THE PARENT OR THE CHILD, AND ALL WHO TAKE AN INTEREST IN THE SCIENCE OF PHYSICAL CULTURE.

BY

H. RIPPON SEYMOUR

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FIRST-CLASS ARMY CERTIFICATES IN GYMNASTICS, FENCING, ETC.

WITH AN INTRODUCTION BY

WILLIAM TAYLOR, M.D., F.R.C.P.E.

ILLUSTRATED.

"Mens Sana in Corpore Sano."

EDINBURGH: E. & S. LIVINGSTONE.

THE MUSCULAR SYSTEM.

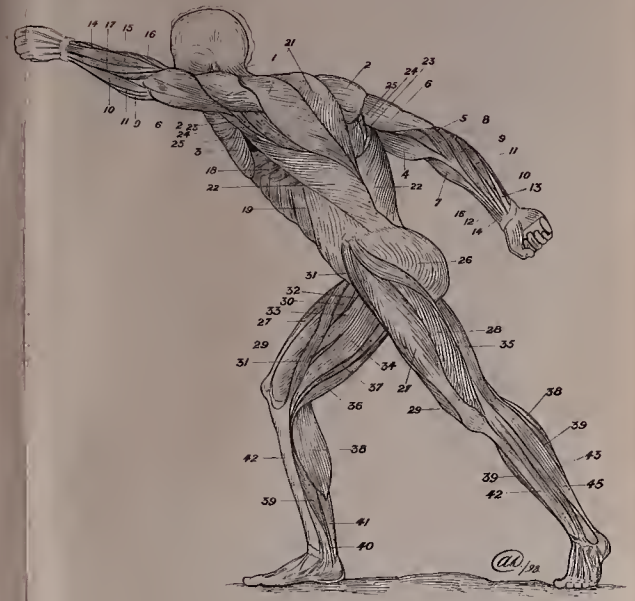
PLATE I.



1. Sterno-Cleido-Mastoid.
2. Deltoid.
3. Pectoralis Major.
4. Biceps (Cubiti).
5. Brachialis Anticus.
6. Triceps.
7. Supinator Radii Longus.
8. Pronator Radii Teres.
9. Flexor Carpi Radialis.
10. Flexor Carpi Ulnaris.
11. Palmaris Longus.
12. Flexor Pollicis Longus.
13. Flexor Sublimis Digitorum.
14. Extensor Pollicis.
15. Extensor Communis Digitorum.
16. Extensor Carpi Radialis.
17. Extensor Carpi Ulnaris.
18. Serratus Magnus.
19. Obliquus Externus Abdominis.
20. Rectus Abdominis.
21. Trapezius.
22. Latissimus Dorsi.
23. Teres Major.
24. Teres Minor.
25. Infra-Spinatus.
26. Gluteus Maximus.
27. Rectus Femoris.
28. Vastus Externus.
29. Vastus Internus.
30. Pectineus.
31. Sartorius.
32. Adductor Brevis.
33. Adductor Longus.
34. Gracilis.
35. Biceps Femoris.
36. Semi Tendinosus.
37. Semi Membranosus.
38. Gastrocnemius.
39. Soleus.
40. Plantaris.
41. Tendo Achillis.
42. Tibialis Anticus.
43. Peroneus Longus.
44. Peroneus Brevis.
45. Extensor Digitorum Pedis.

THE MUSCULAR SYSTEM.

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INTRODUCTION.

I HAVE been asked to write a short introduction to this work, and the subject is "Life"—a subject far too wide for the prescribed limits. "For what is your life?" asks the Apostle,* and his answer has no relation to the subject itself, but only to the brevity of its duration. Life has been compared to a web, of which time is the warp and conduct the woof. The resulting texture depends upon the weaver and the manner in which he utilises his materials. To enable us to do this properly and creditably is the aim and end of all didactics, but "so much fate, so much irresistible dictation from temperament and unknown inspiration enters into it that we doubt if we can say anything out of our own experience whereby to help each other."† Assuming a certain uniformity in the majority of natures, we can devise rules and lay down principles for the conduct of life, which, if followed faithfully, will lead to uniformity of results. Bacon has well enjoined: "in sickness respect health principally, and in health, action; for those who put their bodies to endure in health may in most sicknesses

* James iv. 14. † Emerson.

which are not very sharp, be cured only with a diet and tendering." This inducement alone ought to suffice as an encouragement to bodily exercise, but he might have gone further and said that they who wisely exercise their bodies are able to ward off sickness so that they seldom need to recover from it. Life without health is hardly worth living. The promotion of health ought, therefore, to be the primary object of every individual, and nothing tends so much towards this as well-regulated bodily exercise; and as whatever is worth doing is worth doing well, we ought to learn so to apportion that exercise that every member receives its due share—in youth for favouring healthy development, in manhood for maintaining it, and in age for prolonging it. It is with the object of assisting to do this in a systematic manner that the following pages were written, and I would commend their careful perusal to persons of all ranks, stations, professions, and occupations, for no one can be happy without health, and no one can be healthy without bodily exercise.

WILLIAM TAYLOR, M.D., F.R.C.P.E.

PREFACE.

THE subject of Physical Culture should be of world-wide interest, but until recently the fact that a sufficiency of bodily exercise was an absolute necessity (nay! a primary condition of a healthy life) was not frankly admitted.

Sydenham, a great Physician of the 17th Century, said on his deathbed, "I am content to die, since I leave three great physicians behind me." When asked to whom he referred, he replied, "Air, water, and exercise."

Theoretically these agents in a healthy life have been long admitted, but scarcely practised. We may to some extent account for this apathy in a matter so nearly affecting the general health by blaming the medical men of the day (I speak of a century ago).

It was naturally much easier to pander to the evident wish of a patient, and prescribe "Sedatives for his nerves, provocatives for his appetite, and narcotics to secure sleep," than to prescribe exercise and yet more exercise.

One must not forget, however, that they were compelled, to a certain extent, to order the fashionable remedies of the day.

We who live to-day have reason to be thankful, for medical knowledge has made vast strides since then, and all medical men now admit the great use and necessity of exercise; though, possibly, Sir Benj. W. Richardson and the French physician Lagrange have been most influential in placing before the public the results of their study of athletics from a physiological point of view.

Body and mind are great gifts and for the proper use and keeping of them we are held fully responsible by nature.

Dr T. J. Graham, in a work entitled "Sure methods of improving health and prolonging life," published in 1831, says —"Of all the means of preserving health, exercise is perhaps that which has had the least justice done to it by medical writers. Within the last few years, indeed, gymnastic exercises have come into frequent use and most people are aware of some of the advantages of exercise; but the public at large are still far from having attained to any correct or adequate knowledge of its uncommon power in preserving health, augmenting corporeal strength, improving the mental faculties, assisting in curing disease and contributing to the prolongation of life."

Slowly though surely the general public are awakening to the knowledge that bodily exercise is as necessary as mental for the well-being of the individual and the community.

Year by year, Physical training is becoming more general in our schools and colleges and more appreciated

by our young men in business. Under many school boards, the teaching of drill and gymnastics is a compulsory item of the educational system, and teachers are required to obtain certificates in one of these subjects from some qualified Association.

This is unquestionably as it should be, for if we are to believe in the modern theory of "the survival of the fittest," we must needs fit ourselves for survival.

Man is most certainly the finest animal on this planet; for, notwithstanding many arguments as to the physical superiority of the brute creation, his power of standing either heat or cold is unsurpassed by any other animal, and his muscular versatility excels by far that of all other animals.

This physiological superiority combined with peculiar mental powers naturally place man at the head of the animal kingdom.

It is said, and truly, that "the proper study of mankind is man," but the majority of books written on this subject are too scientific, too "dry" for the general public, or those who have not had a medical training. This attempt at connecting the theoretical and practical sides of physical training in one book is, so far as I am aware, the first of its kind.

To properly appreciate the benefits of physical development, and to actually obtain such benefits to the full, an elementary knowledge of the cause and effect of movement is necessary; in other words, a study of elementary Physiology and Hygiene must be undertaken.

To combine this theoretical with a practical knowledge in a concise and intelligible form is the aim of this work. Scarcely anyone will deny that exercise is necessary to the due preservation of health and strength, yet few trouble themselves to ascertain the effect of bodily motion from a physiological point of view.

It is, however, precisely this knowledge which makes muscular exercise so much more interesting and of so much more benefit than the same exercise taken simply as a task.

The labourer who carries bricks up a ladder, and the gentleman who fences, or plays tennis, both physiologically perform work, in that they blend bodily exercise and labour in the fundamental principle of "muscular contraction."

The gentleman differs from the labourer because he regulates the amount of his exercise, observes the necessary rules of hygiene, of food and rest. The latter, on the other hand, works hard that he may earn his bread, sleeps too little and feeds himself, let us say, unwisely.

Hence, exercise strengthens the one and work wears out the other.

My object then is to place a few physiological facts in an interesting form, and to detail some few exercises with dumb-bells, and so-called free gymnastics, &c., touching on the relative merits of various games, in order that readers may combine theory with practice.

I hope that this book may be read and its recommendations carried out by women as well as men, for the

muscular and bone systems of both are so much alike that, except in a few cases of particular weaknesses, what is good for the one is good for the other.

It is necessary, however, for women to remember that if their health is not of the best they must enter on this kind of work with caution, and probably under medical advice.

Any exercise which makes a great demand on their muscular system must be gradually and slowly increased, and this admonition is the more necessary because the larger proportion of our women-kind neglect to observe even the simplest rules of health.

"Where women lead an active and unfettered life their strength and endurance nearly equals that of man, and the 'weaker sex' would be so only in name if they would but dress sensibly and take more healthy exercise." *

A year of good healthy exercise for a girl of sixteen will do more for her ultimate beauty of form and face than all the lotions, pomades, and corsets ever invented. I have noticed that exercise has a remarkable and immediate effect on a woman's complexion. In a few months, I have seen and have made the greatest possible changes in young women under my own training, and interesting as the development of a man undoubtedly is, the changes in women in this respect are infinitely more striking, and, needless to say, pleasing.

* Checkley.

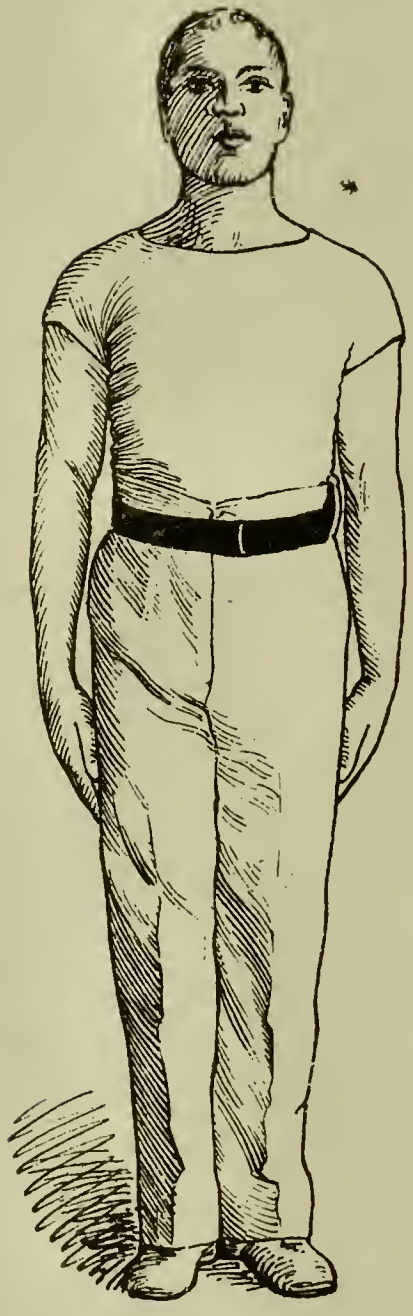
Let me hope then that this book may assist in bringing the great gifts of health and strength to all who may read it, and that many may bless the day they first saw the truths contained herein.

The writing of this work has necessitated many references to, and use of, opinions of other writers—medical and athletic—and no fixed rule has been observed in the mention of their names. The names of authors whose works have in any degree assisted me, or whose opinions have been quoted, are duly noted in Appendix, No. VI.

It is only fair to mention, however, that the greatest founders of the "Health and Exercise" School are undoubtedly Fernand Lagrange, M.D., Dr Gordon Stables, the late Sir Benjamin Ward Richardson, Dr Oscar Jennings, and Edwin Checkley, of America.

I desire to acknowledge my indebtedness to Dr W. Taylor, for his assistance and for his introductory notice; to Mr J. A. Doig, M.A., and Mr Alex. Dandie, of George Watson's College, Edinburgh—the former for his assistance in revising and correcting both manuscript and proofs, the latter for his original anatomical drawings.

H. RIPPON SEYMOUR.



"ATTENTION."

CHAPTER I.

ELEMENTARY ANATOMY.

ANATOMICALLY the body may be divided into three parts—Head, Trunk and Limbs. The Skeleton is the framework upon which the body or soft parts are built up, and consists of 197 bones, omitting the teeth, small bones of the ear, patellæ, &c.

The Head consists of the skull and bones of the face, the skull being formed of several flat bones firmly united together.

It is divided into forehead, occiput, temples, and base. The bones at the back are the "occipital," and they are the thickest; being also strengthened by ridges on their inside.

The base of the skull may be described as the "floor," and forms the cavity which contains the brain.

The face bones are—the two upper jaws; the two nasal bones, which form what is termed the "bridge" of the nose; and the bone called the *nasal septum*, which divides the nose into two nostrils; the two palate bones forming the roof of the mouth, and the lower jaw. In the jaws are 32 teeth in all.

The skull rests on the spinal column; a series of 24 hollow bones held firmly together by an elastic ligament between each. These bones are called *vertebrae*, and the circular openings or hollows form, when they are joined, the spinal canal containing the spinal cord (see chap. on Nervous System).

The seven highest vertebrae form the neck, and are called "Cervical," the twelve next are called "Dorsal," and to them the ribs are attached. The two highest cervical vertebræ are most specially concerned in supporting the head, the uppermost being called the "Atlas" which allows the head to be moved backward and forward (nodding). The second named the "Axis" admits of the head being moved from side to side, or in the manner usually indicating negation.

The ribs spring forward from the cervical vertebrae in a semi-circular manner, the seven highest joining directly on to the "Sternum" or breast bone—a flat bone running vertically downward a short distance in the centre of the chest—thus forming with the ribs and spinal column a cavity, or box, from whence we get the term "chest."

The next three ribs lower are joined by means of cartilage to the higher ribs, curving upwards in so doing, and the lowest two are much shorter and do not come to the front at all. These are known as floating, or false ribs.

Below the "dorsal" we find the five "lumbar" vertebrae, the lowest of which rests on the "sacrum."

The *sacrum* is a wedge-shaped bone forming the posterior wall of the pelvis, and in youth is composed of five separate portions of bone not unlike vertebrae.

The *two hip bones* join together at an angle in front, and form the sides of the pelvis.

The upper part is called the "ilium," and the lower and back part the "ischium," and the front part the "os pubis."

The lowest portion of the spine, the "coccyx," consists of three, four, or even in some instances as many as five separate bones.

The *ischium* supports the body when sitting.

The *thigh bone or femur* fits into a cup-shaped hollow, the "acetabulum," at the point where these three bones unite.

The *shoulder*, which belongs to the trunk consists of two bones, viz., the shoulder blade or "scapula," and the collar bone or "clavicle."

The *scapula* bears the socket or "glenoid cavity" for the shoulder joint, and the *clavicle* is fixed by cartilage at one end to the breast bone, and at the other to the shoulder blade.

The joints of the limbs are of three kinds, viz., ball and socket, pivot or hinge joints, and the wrist and ankle joints, the latter of which are very intricate articulations, admitting of very free and diverse movements.

Movements can only be made in one direction with the hinge joint (elbow, knee).

The ends of bones articulating with each other to form a joint are made to fit almost perfectly, and are covered with a smooth shiny cartilage, "synovial membrane," continually lubricated with what is called the "synovial fluid."

The kind of movement as regards freedom depends greatly on the tightness of the ligaments which unite

the ends of bones forming a joint, and also on the shape of their opposing surfaces.

The arm is formed with three bones—one in the upper arm called the *humerus*, whose upper end fits into the shoulder blade, and forms a ball-and-socket joint. The lower end which forms the elbow is joined to the two bones in the forearm, making a hinge joint.

The bones in the forearm are called respectively the "ulna" and "radius."

The ulna is on the inner or little finger side, and the radius on the outer or thumb side. The radius not being in contact with the "humerus" admits of that rotatory movement producing the positions of "pronation" and "supination" of the hand. The lower ends of both these bones form with the bones of the hand the wrist joint. The wrist or "Carpus" consists of eight small bones, placed in two ranges each of an equal number.

The hand is formed of five *metacarpal* bones which can easily be felt at the back, the knuckles being their rounded lower ends.

The fingers have each three small bones and the thumb two, which are called "Phalanges."

Each metacarpal bone articulates with a finger.

The lower limbs are somewhat similar in their construction to the upper.

As before mentioned the rounded head of the "femur" or thighbone, which is the longest and strongest bone in the body, fits into the *acetabulum* formed by the junction of the ischium, ilium, and os pubis.

The head of the femur is set on the thigh bone

at an obtuse angle and not a direct continuation in a straight line.

At this angle and pointing outwards is a bony prominence called the "great trochanter," which can easily be felt on the outside of the thigh. The head of the femur is strongly connected with the acetabulum by means of three ligaments, one of which, the "round" ligament, arises from the centre of the head of the femur, and blends with the "transverse ligament" which latter forms a ring round the acetabulum.

In the leg below the knee are two bones, the "tibia" or shin-bone, which may be felt in front, and the "fibula," a thin bone, well protected by muscles, on the outer side of the leg.

The upper end of the tibia forms with the femur the knee-joint, in front of which lies the "patella" or knee-cap.

The lower ends of tibia and fibula, united to the bones of the foot form the ankle joint.

The two prominences seen on either side of the ankle are formed by the ends of the tibia and fibula.

The foot is composed of a very large number of bones, which are called *tarsus, metatarsus,* and *toes.* The tarsus, which is the hinder part, is composed of seven short, strong, bones. The strongest of these has a projection backwards, forming the heel or "os calcis."

The seven tarsal bones articulate with five metatarsals, which then articulate with the toes.

The following bones can be easily felt on one's own body, and will materially help in their placing and

recollection — The bones of the skull, sternum, shoulder-blades, ribs, clavicle, elbow, forearm, hand, vertebrae, sacrum, ilium, ischium, pubis, great trochanter, knee, knee-cap, the tibia, ankle, and bones of the foot.

Our whole skeleton has been constructed so as to give the greatest possible strength with least weight, many of the bones being hollow. The whole bony substance of the "vertebrata," or backboned animals, is pierced with various cavities and canals, which are filled with nutritious fluids of various kinds.

The proportion of the mineral constituents of bone substance is nearly as follows:—57 parts of phosphate of lime, 8 of carbonate of lime, 1 of fluoride of calcium, 1 of phosphate of magnesia.

Bones also contain, besides cartilaginous substances, greater or less quantities of fat, and albuminoids arising partly from the bloodvessels of the bones.

The bones of young children are poorer, and those of old persons richer, in mineral constituents than those of adults.

The minerals cause the bones to become hard and brittle, and thus a fall that would not hurt a young person might easily break the leg of a person over 50 years of age.

The circulatory system, by means of which the blood is carried to every portion of our bodies, consists of the *heart*, which may be compared to a pump continually keeping the blood in movement; the *arteries*, which are the means of distributing the blood when freshly oxygenated from the lungs, and the *veins*, which collect the blood after it has served its primary purpose, and return it to the heart.

The arteries are strong and elastic tubes, which gradually branch and sub-divide, becoming smaller and smaller until they eventually reach every portion of our frame, and are then called *capillaries.*

The veins are similar to the arteries, but their construction is slighter and the walls thinner. They possess valves composed of thin membrane, which prevent the blood taking a backward course; a most necessary restriction considering the purpose they serve. Arteries and veins are classed together as bloodvessels.

The *heart,* the centre, and probably most important organ of the circulatory system (if not the whole body), is divided into two halves vertically, right and left, which are again subdivided horizontally into two smaller chambers, the upper of which are called *auricles* and the lower *ventricles.*

The *right half of the heart* sends the blood through the *pulmonary* artery to the lungs to be relieved of its carbonic acid, &c., and to receive in exchange oxygen. (See chapter on "Physiology of Exercise,")

From the *left half of the heart* the blood is sent in circulation to convey nourishment to the various organs of the body.

The course pursued by the blood is as follows :— The bright red, or arterial blood enters the left auricle, passes into the left ventricle, and thence through the arteries in general. After having been all round the body it returns as dark, or venous, blood to the right auricle, and then through the right ventricle to the lungs for purification and oxygenation.

Thus the blood of human beings is passed twice through the heart, and forms a double circulation,

the larger of these being called the *Systemic* circulation and the smaller the *Respiratory.*

The capillaries are the real medium from whence the tissues take up their oxygen and peculiar nutriment and at the same time give back the used-up material.

The capillaries then enter the veins, whose duty is to carry this blood back to the heart.

The blood flows much slower in the capillaries than in the arteries, one reason being to give the tissues sufficient time to absorb the necessary nutriment.

There are four auxiliary aids to circulation—1st, aspiration of the thorax; 2nd, muscular movements of the body; 3rd, contraction of the walls of the veins; 4th, vital attractive power of the tissues.

For the purposes of this book the explanation of the second will be sufficient, viz., muscular movements of the body assisting the flow of blood, the rationale of which is fully described in the chapter on "Physiology of Exercise."

The whole system of circulation is purely mechanical, and is a perfect illustration of the natural law of supply and demand.

It is scarcely necessary here to mention the liver and its functions, or indeed any of the organs situated in the abdomen. It will be sufficient to state that the liver is a large organ situated immediately under the diaphragm and on the right of the stomach, principally concerned in the digestion of food, and well supplied with blood capillaries. It is here that the food is chemically changed and made fit for reception by the blood, being operated on by the bile, bilin, cholesterin, &c., each of which play an

important part in these chemical changes. The bile is not, however, merely a secretion, but is food for the system, and it has three distinct functions.

The first is its secretion; the second is that after entering the intestine it becomes re-absorbed, and becoming oxydised is made of further use in the production of heat and work; the third being its use in digestive purposes.

The liver is very susceptible to the effects of exercise or the want of it, the latter causing what is known as "sluggish liver," interfering with the digestion, and bringing a whole host of evils in its train.

The muscles and nerves, which are of course included in the subject of anatomy are not mentioned here, having each a chapter devoted to them. The lungs also are fully considered in the chapter "Physiology of Exercise."

CHAPTER II.

THE MUSCULAR SYSTEM.

FOR the purpose of gaining a fair knowledge of the benefits and effects of exercise on the various portions and systems of the body, an acquaintance with our muscular system is necessary.

The Muscular, controlled *entirely* by the nervous system is responsible for every movement made by us, and when we consider that even the act of standing requires comparatively, a great muscular effort, we begin to see that there is an evident necessity for understanding something of such a wonderful and beautifully balanced system.

Muscles are of two kinds, viz:—voluntary and involuntary. The voluntary muscles are nearly all situated *outside* the frame-work or skeleton, and are moveable at will.

The involuntary muscles are for the most part situated within the body and, as their name implies, are not under the direct control of our will, but of the "sympathetic" nervous apparatus.

Some muscles are, however, either voluntary or involuntary according to circumstances. The eyelids, for instance, can be closed at will, or automatically (by a reflex movement), as on the approach of

some possible danger to the eye; on the other hand they are continually raised and lowered involuntarily all day in order to keep the eye clean.

The muscles which work the lower jaw are also practically either voluntary or involuntary. In eating, for example, we do not have to use any direct will power to masticate our food, this movement becoming automatic, yet we can on the other hand close our mouth with such force that it would require a lever to open it. Amongst the involuntary muscles, the principal are the system of muscles forming the heart; and the muscles concerned in the act of swallowing and breathing.

The voluntary muscles are principally referred to in this chapter; those of the involuntary system, it has not been considered necessary to mention, as being beyond the scope of this work.

There are such an enormous number of muscles in the body (527) that in a work of this size and description, only the principal can be noticed. Many of the minor muscles are simply continuations or subdivisions of the larger; they gain their development from the use of the larger, and in many cases they simply serve to modify any given movement produced by the larger muscle.

The various terms used to explain the movements given to a limb by the muscles, are as follows:—A limb is said to be "flexed" when it is folded on itself. The straightening movement is called "extension." The muscles responsible for these movements are called respectively "flexors" and "extensors."

To "adduct" is to bring a limb in towards the body; to "abduct" is to carry from, and in a different

direction to that of the axis of the body, hence the muscles concerned in these acts are called "adductors" and "abductors."

The act of "supination" refers to that movement of turning the palm of the hand or front of the body upward. "Pronation" is the reverse movement.

The movement from "Pronation" to "Supination" of the hand is called "Rotation," and must not be confounded with "Circumduction," which latter is the movement made by the forefinger and hand in describing a circle on a blackboard. When the arm is "flexed" the hand is "rotated" from and with the elbow joint, but when the arm is extended, it is made from the shoulder, the rotatory motion of the elbow being then lost.

A recollection of the foregoing names of movements will greatly assist in the general understanding of the remainder of the chapter; many muscles simply being distinguished by the affix of "flexor," "extensor," "adductor" or "abductor."

MUSCLES OF THE NECK, CHEST, &C.

Let us commence with the upper part of the neck behind, always remembering that a constant reference to the plates is necessary to impress more fully the names and positions upon us.

1. *Sterno-cleido-mastoid* — One is situated on either side of the neck starting immediately behind the ear, and coming forward to the top of the collar bones. Their office is to move the head from side to side, but if both work simultaneously the head is pulled forward.

2. *Deltoid*—So called from its supposed resemblance to the Greek letter delta Δ.

It is in three divisions, and its principal duty is that of raising the arm above the head, either outwards or to the front or rear, according to the portion of the muscle which is most actively in use. It is a muscle capable of great development, and is found to be large as a rule upon those practising rope climbing or weight lifting to any extent.

3. *Pectoralis major*—A large flat fan-shaped muscle, whose end is inserted into the *humerus* just under the shoulder. It adducts the arm, carrying it across the chest towards the horizontal plane.

In a bird this muscle, in conjunction with the deltoid, is the motive power of flight, and has usually an abnormal development.

In some birds, capable of flying great distances, the *pectorales* exceed in weight the whole of the remainder of the muscles put together.

MUSCLES OF THE ARM.

4. *Biceps*, which act in conjunction with:—

5. *Brachialis anticus*, to flex the arm at the elbow, are the principal muscles used to raise oneself to the breast when hanging on a bar.

6. *Triceps*—So called because it has three heads or ends. It is used to extend or straighten the arm.

7. and 8. *Supinator radii longus* and *Pronator radii teres*—These muscles which are on the front of the forearm control the movements of supination and pronation, the former being assisted greatly by the biceps in its movement.

9. and 10. *Flexor carpi radialis* and *Flexor carpi ulnaris*—These muscles flex the wrist on the front of the forearm.

11. *Palmaris longus*—Flexes the hand towards the back of the forearm.

12. *Flexor pollicis*—Flexes the thumb.

13. *Flexor sublimis digitorum*—Flexes the fingers on the palm of the hand.

On the back of the forearm will be found the extensor muscles which reverse the movements made by their flexors. They are :—

14. *Extensor pollicis*—extends the thumb.

15. *Extensor communis digitorum*—extends the fingers.

16 and 17. *Extensor carpi radialis* and *Extensor carpi ulnaris*—which assist each other in bending the wrist laterally outwards.

MUSCLES OF THE TRUNK.

Returning again to the body, let us resume immediately under the armpit, where we find—

18. *Serratus magnus*—This muscle which runs obliquely downward and a short distance forward is used in drawing the trunk and shoulder forward.

19. *Obliquus externus abdominis* co-operates with and assists the—

20. *Rectus abdominis*—which flexes the trunk forwards. This latter muscle is of great assistance in "exercises of suspension from the hands" when the legs are required to be raised.

Look now at the muscles situated on the back of the trunk. Immediately behind and below the neck we have the—

21. *Trapezius* — This is a broad flat triangular muscle arising from the occiput, neck, and dorsal vertebræ, and its outer end is inserted into the collar bone and upper part of the shoulder blade. It operates in bringing the shoulder blades inward together and in drawing back the head, thereby expanding the chest. It can also assist in raising (shrugging) the shoulders.

Immediately under, and hidden by the *Trapezius*, are situated two muscles, called the *Levatores anguli scapulæ*, which lift the shoulders. They cannot be seen on the plates as they are also covered by the *Sterno-cleido-mastoid.*

22. *Latissimus dorsi*—A large mass of muscle occupying most of the space between the armpit and hip. It is seen to advantage in swimmers and boxers, as it is principally used to draw the arm backward and downward. It is popularly known as the "swimming muscle," and is capable of great development.

Just behind the upper arm, and higher than the *Latissimus* are the—

23. *Teres major*, 24. *Teres minor*, which assist the *Latissimus*, and 25. *Infra Spinatus*, which moves the shoulder joint outwards.

Immediately below and behind the hip-joint we have great masses of muscle.

26. *Gluteus maximus*, which forms the buttock, its function being to extend and abduct the thigh, and also rotate it outwards.

It co-operates with several muscles in the back known conjointly as the—

Erectores spinæ, in keeping the body erect.

MUSCLES OF THE LEG.

In front of the thigh is another great mass of muscle known as the *Quadriceps extensor*, being, as the name implies, four extensor muscles, each co-operating with and assisting the others. They are—

27. *Rectus femoris*, 28. *Vastus externus.*

29. *Vastus internus* and the *Crureus*, which latter is hidden by the other three, and cannot therefore be seen in the plates.

This mass of muscle is principally used in the powerful thrust required in cycling, and also in swimming.

30. *Pectineus*—helps to flex and rotate the thigh outwards.

31. *Sartorius*—known as the "tailors' muscle;" a long flat muscle crossing the thigh diagonally downwards and inwards. It bends or flexes the leg at the knee.

32. *Adductor brevis*, 33. *Adductor longus* and 34. *Gracilis* adduct and flex the leg, assisted by the *Adductor magnus*, which is too deeply hidden to be seen.

Behind the thigh and antagonistic to the *Quadriceps extensor* are situated: 35. *Biceps femoris*, which is aided in flexing the knee by—

36. *Semi tendinosus* and 37. *Semi membranosus.*

The *Biceps femoris* rotates the leg outwards and the semi membranosus inwards.

The calf of the leg is formed by a combination of three muscles which extend the foot as in walking. They are the—

38. *Gastrocnemius.* 39. *Soleus* and 40. *Plantaris.* The first two of these are united toward their base, and form a very strong sinew called the (41). *Tendo achillis*, which is joined on to the projecting heel-bone, or *Os calcis.*

By means of this tendon and the muscles of the calf of the leg, the whole weight of the body is levered forward in the act of walking.

The front of the leg (the shin) contains—

42. *Tibialis anticus*—This muscle draws or flexes the foot upwards on its inner edge.

43. *Peroneus longus* and 44. *Peroneus brevis* extend the foot.

The muscles in the foot are, like those in the hand, very numerous, but for the purposes of this book it is scarcely necessary to describe them.

The whole of the muscles mentioned in this chapter, with the exception of those two or three too deeply hidden, can be seen and felt on any fairly developed man, and it would be well for the reader to make himself acquainted with their position with regard to himself.

Having given a list of the principal muscles, it is now intended to explain what muscle is, and by what means it performs the functions allotted to it.

MUSCLE STRUCTURE.

Muscle is composed of bundles of fibre or *fasciculi,* and these bundles are separated from each other by cellular tissue.

Each *fasciculus* is composed of a large number of fibres, which eventually join at one point in a prolongation of connective tissue, and these fibres are again resolved into fibrillæ, which are composed of small tubes containing a fluid, the essential constituent of muscle.

Every fibre is surrounded by a kind of envelope known as its *sarcolemma,* which contains an almost fluid substance, which under the microscope is seen to be fibrilar.

The muscles are not everywhere the same in shape, size, or fibre. Those from which a large amount of work or strength is expected are found to be much coarser than others.

For example, the Deltoid, or Gluteus Maximus are both large and hard worked muscles, and consequently have much coarser fibres than the muscles of the face.

Exercise has a tendency to coarsen the fibrous structure of a muscle, except, perhaps, in the case of women, who never present the hard and prominent muscular development of a man, no matter what exercise they take.

It is for this reason that the flesh of bullocks used as beasts of burden, is coarser and tougher than that of grazing animals.

The fibres of voluntary muscles are somewhat spindle-shaped, being upon an average $1\frac{1}{2}$ inches long, and $\frac{1}{400}$ of an inch in diameter, their ends being either single or branched.

When a voluntary muscle is stripped of its outer covering of skin and tissue it is seen to be striped with dark red rings. These stripes or rings are not seen in the involuntary muscles, with the following exceptions :—

The *Pharynx*, *Œsophagus*, *Heart*, and *Bladder*, the latter of which being to a great extent under control of the will is not entirely an involuntary muscle.

It may then be considered as a general rule that voluntary muscles are ringed, and involuntary are not, recollecting that every rule has its exception.

A movement is made by the contraction of a muscle, and it follows that a similar contraction is necessary on the part of the antagonistic muscle before the limb can resume its previous position.

For instance, to flex the arm at the elbow a contraction of the *biceps* is necessary; to extend it the antagonistic muscle, in this case, the *triceps*, must be contracted.

A muscle is made to contract by means of certain "stimuli," either by the usual nerve-stimulus, electric or galvanic stimulus, chemical stimulus, thermal stimulus, (which is the sudden application of heat) or by a sudden light blow given when the muscle is tense.

These stimuli also act on any muscle if applied to the motor nerve having immediate connection with that muscle.

A muscle may be acted upon in precisely an opposite manner by the taking of any powerful narcotic, which produces a temporary paralysis of the nerves. A poison known as "Curari" has the peculiar power of paralysing the motor nerves *only*, and although the brain be at the time quite clear the limbs absolutely refuse to move.

A muscle is intended to perform certain labour according to its shape. Thus a long slender muscle should raise a light weight a great height, while a thick heavy muscle can raise a great weight a little height. The amount of work performed by a muscle is found by multiplying the weight moved by the height the weight is lifted. Thus the power or dynamic force required to raise 3 lbs. 1 foot is the same as to lift 1 lb. 3 feet, and would be expressed as 3 "foot-pounds" in both cases. In France this power is estimated in "*Ergs.*"

Contrary to general ideas muscle has more than one use.

It has three distinct functions or properties which are :—

1. The power of "movement."

2. The power of "passive resistance," as when employed in holding the arm out from the body, the power used or work performed being increased greatly when the hand holds any weight, on account of the greater leverage.

3. The property of "latent stimulation," as when a cat crouches for a spring, or a runner waits for the pistol report to start him in a race. The fatigue arising from this last use of the muscles is far greater than when performing ordinary movements because in addition a vast amount of nervous force is expended.

Now a chemical process is continually at work in the muscles and the constituent parts are always warring as it were one against the other. This chemical activity produces, even when the body is entirely at rest, a certain amount of heat. The amount of heat produced when the muscles are being worked naturally varies in proportion to the amount of work performed. This heat is the primary cause of perspiration and combustion of tissue, and is more fully explained in the chapter on "Physiology of Exercise."

Our muscles are made to obey the will by means of the motor nerves which are connected immediately with the brain or spinal cord (and which are fully dealt with in the chapter on the "nervous system"), but the property by which they respond to the message from the brain is called "muscular irritability."

The muscles have the peculiar power of adapting themselves to requirements, increasing in size when used carefully and systematically, and decreasing and in some cases becoming entirely atrophied through disuse. They are to us what the wheels and cranks are to an engine. The food we eat is the fuel, the steam generated in the boiler in us becomes "action," the muscles like machinery being made for use and movement.

It behoves us therefore to make use of them in a proper manner.

They have been given us for use, not for idleness, and they are perfectly willing to work and serve their owner if given a fair opportunity.

The Heart, one of the most important combinations of muscles, never rests until the last, and with careful and judicious training can be made strong and perfectly healthy.

Sufficient has now been said about the muscles as regards their physiology. In the chapter on "Muscular Development" exercises are given for every principal muscle, which if practised as they should be, must have the desired effect, viz., that of increasing their strength, size, and activity.

It must be distinctly understood that the foregoing is merely a superficial list of the muscles, no notice having been taken of those which cannot easily be seen on the plates, and which any attempt to indicate would simply lead to confusion.

CHAPTER III.

THE NERVOUS SYSTEM.

IT is hardly necessary for the purposes of this work to go into the physiology or chemistry of the nervous system, but a few facts as to the number and position of the principal nerves and their functions, will be sufficient.

The nervous system consists of the brain, the grey matter therein, the spinal cord, and the network of nerves branching off these. Of all the tissues, the nerves have the simplest structure, having only one fundamental tissue, viz., the white matter.

The Brain is the highest centre of the nervous system, and is the seat of thought and will or volition. Of its chemical composition little is known. It contains a grey matter, which is universally considered to be its vital essence.

The Spinal cord, which is apparently formed of the union of all the nerves, is in shape like a white cord, and is in reality a continuation of the brain substance; it passes through the spinal canal (formed by the hollows in the centre of the vertebræ), from the intervals in which the spinal nerves pass out on either side, and so on over the whole

body, lessening in thickness, and increasing in numbers as they sub-divide.

In man and most other animals nerves occur in two forms, either as separate delicate cords which divide into many parts and distribute themselves throughout the body, and are the nerves proper; or collected in masses. These latter are called *nerve centres*, and are enclosed in either the skull or vertebral column.

The nerve-system, by which is meant both the forms before mentioned, effects the motions and sensations of the body. These qualities belong mainly to the nerve centres, as the nerves proper merely act as a conducting or transmitting apparatus.

Nerves are of two kinds, viz., *spinal* and *cranial*. The Spinal nerves are in thirty-one pairs. The Cranial nerves are of two kinds—Anatomical and Physiological.

Anatomically there are nine pairs of cranial nerves. Physiologically there are three, viz., 1st, nerves of special sense; 2nd, motor nerves; 3rd, nerves of common sensation.

Generally speaking, the *cranial* nerves convey the mandate of the will, and the *spinal* are merely conductors, excepting where as before said they form a nerve centre situated in the spinal column.

We may now proceed to examine the peculiarity of the various actions of the nerves and nerve centres.

So long as a nerve fibre passes uninjured from the brain or spinal cord to a muscle, that muscle can be contracted either by the will or automatically.

It must be distinctly understood that no movement of any muscle whether voluntary, involuntary, or automatic, can be made unless through the excitement in some manner of its own nerve or nerves.

"Our knowledge of automatic movements is based principally on those connected with respiration, and the knowledge gained by this means may be applied to other cases."

Respiration begins immediately after birth, and its movements continue with more or less regularity during life. In man and the higher animals this respiration is unconditionally and absolutely necessary for the preservation of life, for only by this means is sufficient oxygen conveyed to the blood to provide for the necessary vital processes.

Now the nerve centre responsible for the muscular excitement of the lungs is situated between the first and second vertebræ in the "*Medulla oblongata*" and is formed of a mass of nerve cells from which proceed the nerves to the respiratory muscles. If this organ or centre be injured, life immediately ceases, and in cases of hanging is found to be crushed or otherwise injured by the so-called dislocation of the neck.

The gasping or choking sensation felt on entering a room full of foul air, gas, or smoke, is the immediate action of the same nerve centre. The lungs which have inhaled a quantity of this gas, &c., have permitted the blood to take up a small quantity of it also. This vitiated blood on passing through the respiratory nerve centre excites it and causes spasmodic movements of the respiratory muscles, which we call "gasping."

The conducting nerves are divided into two kinds, viz.:—*motor* and *sensory*, the former as their name implies being responsible for *movement*, whether voluntary or involuntary, the latter for *sensation* such as touch, taste, sight, smell, or hearing.

Motor nerves may be compared to the wires which convey the electric fluid from an electric motor to a receiving apparatus, for they convey the stimuli from the brain to the muscle.

A peculiarity is that a transference can take place between the excitement of a *sensory* nerve and a *motor* nerve and this change from sense to movement is called *reflection*.

As far as is at present known, when a sensory nerve receives excitement or impression, the excitement is conveyed to the nerve centre, and from thence conducted away until it makes its appearance at another point. This reflection may make its appearance in a motor nerve, and the movement made by the contraction of the particular muscle affected is then called "*reflex*."

As simple examples of such reflex actions may be mentioned the closing of the eyelids on the irritation of the sensory nerves of the eye, sneezing on the irritation of the mucous membrane of the nose, the sudden movement made by a person surprised by either a blow or a startling sound, or the drawing away of the hand on touching an unexpectedly hot article.

The antithesis of a reflex action is a primary or simple movement, as the majority of movements are during our waking hours. The act of writing, for instance, is a very good example of primary action,

because here the movement of hand and fingers is governed directly from the brain, and by the will, though probably through a nerve centre.

The actual means by which nerve currents are transmitted has not yet been discovered, the nearest approach to it being the passage of the electric fluid along a wire, and indeed the nerves will conduct electricity directly towards the muscle they govern, and the actions of the brain and muscles have been found to generate an electric current.

These facts justify the supposition that there are "channels of propagation," along which the excitatory process is guided and, as it were, exchanged for the motor process.

Reflex actions are of two kinds, *normal* and *abnormal*.

The former spring from the excitation, usually by some feeble stimuli, of one or more of the sense organs and they are characterised by the fact that the same sensations invariably lead to the same muscular actions. For instance the hearing of an unusual or unexpected sound invariably causes the head to be turned in the direction from whence the sound is supposed to be proceeding: or again the taking of snuff invariably causes sneezing.

These normal actions can be multiplied indefinitely and form a large proportion of our movements.

Abnormal or convulsive reflex movements on the other hand do not occur in the average healthy person except as the result of injury or disease.

The movements made by a person suffering from Chorea or "St Vitus' Dance" may be mentioned as an instance of an abnormal reflex action.

It is sometimes stated that the cutting of a motor nerve paralyses a muscle. This, however, is not correct, for the muscles have not really lost their contractility, but are simply removed from the influence of the will. If they be acted upon by other stimuli, as for instance an electric current, they will be found to still retain their power of contraction and will move the bones to which they are attached, even though their motor nerve be cut.

At the same time without the nerves the muscles are practically useless. Cut the slender thread of nerve supplying the arm of even the strongest man and his will becomes exhausted in the vain attempt to move that limb—he cannot do so. Here then we see that the nerves cannot produce movement; they simply transmit to the muscles the stimuli which causes them to contract.

There is, however, a theory that the nerve has the power of augmenting or reinforcing its stimulus, so that a slight stimulus emanating from the brain or nerve centre becomes, by the time it reaches the muscle, a much more powerful one. *(Pflüger).*

If this theory be correct, and the nerve really has the power of amplifying the stimulus received by it, we may believe that, like all other physiological functions, it can be developed by exercise.

This property of amplified nervous stimuli would be an easy explanation of the greater ability of the *trained* than the *untrained* man, who need not always have greater muscles to be stronger or faster, but who can by a moderate or at least an equal effort of will create a more intense stimulation

of the motor nerve, and consequently a more energetic contraction of the required muscle.

Although the spinal cord is white externally like the nerve tissue, in its centre is the *grey matter*. This grey matter makes the spinal cord a nerve centre, which as we have before seen is an organ capable of both creating and conducting a motor stimulus independently of the brain.

Wherever we find one of these nerve-centres, we may be sure that this region possesses a power peculiarly its own and independent of any other part. A bird with its head cut off can still fly a short distance, because the movement of its wings is directed not from the brain but from a nerve-centre lower than the point of section.

A physician once succeeded in keeping alive a dog whose brain he had removed.

The animal was fed, and could walk in a straight line, but would knock against any obstacle in its way, not because it was blind, but because it had lost the power of judgment and reason, which latter comes from the brain only. The power of walking had thus little or nothing to do with the brain, but with some nerve centre in the spinal cord, and was a reflex movement.

Reflex movements must not, however, be confounded with automatic movement.

We must always remember that the brain is not indispensable to the performance of some movements. "*Automatism* is the faculty possessed by certain nervous elements of putting the muscles in action without the intervention of the will." The movements of the heart and lungs are automatic and

involuntary, yet they are not reflex. The movement of walking may be automatic and *voluntary*, and not reflex, so that although reflex movements are made without the assistance of the will all movements made involuntarily are not necessarily reflex.

Take the case of a man much occupied in thinking: he will rise, walk about, and perform various movements of which he has no recollection afterwards. All these are automatic and voluntary actions, and yet the will has no real influence or direction over them.

These movements are caused by stimuli from various nerve centres in the spinal cord, and not from the brain.

To make an exercise become automatic several conditions are necessary; first, there must be absence of *effort*, and secondly there is requisite much practice in the exercise performed.

Walking is probably the exercise which most easily becomes automatic, because of its continual practice, and ease or absence of *effort*.

Movements tend to become automatic sooner when performed with regularity; for instance, music and dancing or marching have always been associated, though no physiological reason can as yet be given why. The rhythm and cadence appear to relieve the brain and nerve centres of the care of directing the muscles and thus fatigue is diminished.

The spinal cord seems to have a "memory of movement," for if once a rhythmic movement be learnt the time and cadence will probably never be forgotten.

A person who has grown into the habit of walking slowly will always walk slowly when the movement is being performed automatically; on the other hand a fencer who has from the first been taught to make every movement quickly, will always be quick in his movements, and we then say he has got "into the habit" of quickness.

Habit then, is simply the memory which the spinal cord and nerve centres acquire, and it will require an effort of the will to oppose an action which has become a habit.

Even a complicated movement, or series of movements may become automatic by constant practice. For example an accomplished pianist can play difficult pieces and yet talk at the same time, and we can say that his thoughts are far from his movements. The repeated performance of the same movement becomes a habit, or in other words a memory is given to the nerve centres responsible for the movements, and they become automatic and quite distinct from movements which the brain directs.

Automatic movements are far less fatiguing than those directed by the brain, and for that reason those who work with their brains should not dream of taking such an exercise as fencing, for example, with the idea of obtaining any real relaxation.

For a man who wishes to rest his mind though he work his muscles, some kind of exercise must be given where the movements proceed from the nerve centres in the spinal column, and if possible must be performed from *memory*, not brain memory, but so-called muscle memory.

Exercises to music with dumb-bells, wands, &c., are practically unequalled in this respect, for they assist in developing muscle while resting the brain.

If on the other hand the person is one whose work or employment is manual, an exercise like fencing, boxing, or the advanced gymnastic exercises must be recommended, for in addition to the muscular labour performed, the brain, especially in fencing and boxing, must be ever on the alert, and is consequently performing a due share of the labour.

The simpler exercises of the gymnasium, however, are suitable for all, as they soon become nearly automatic, and thus can be performed while the brain rests.

Probably the severest strain that the mind can be put to is that of writing original compositions, for here the brain must perform a very arduous task, a dual task, that of formulating the sentences and spelling the words, and also directing the nerve centres responsible for the finger movements.

Even in this case, however, writing becomes almost automatic with continual practice, for it is possible to write (without looking at the paper), and at the same time talk of a totally different subject to that of which we are writing. To continue this, however, for any length of time would be too severe a strain on the brain.

The nervous system of man is perhaps the hardest portion of his complex machinery to understand and explain; and it must be left to the very advanced student of Physiology to attempt to solve some of the intricate problems offered by the study of the nervous system.

For example, some Physiologists have sub-divided the nerves into many more kinds than are here mentioned, in order to distinguish them and in some degree account for the phenomena which are always presenting themselves. The hardest problem yet offered by the nervous system for man to solve is the action of the class of nerves called "retardatory." It is common knowledge that the heart beats ceaselessly during life. Now, if a certain nerve which enters the heart be irritated or stimulated, the heart ceases to beat, recommencing when the irritation of the nerve is discontinued. This phenomenon is called retardation, and is curious as showing how a nerve can by its *activity* "still" a muscle which is in motion. It is supposed, however, that the retardatory nerve when excited causes the motor nerve responsible for the heart's action to cease performing its duty. The details of this phenomenon would involve a long technical explanation which it is not the purpose of this work to include, and would be of no interest to the general reader.

Want of sufficient exercise is considered to have a decided effect on the nerves, showing itself in a loss of excitability (of nerve), which would account for the lassitude felt by persons who do not exercise sufficiently, and it has been found by physicians in post-mortem examinations made on the brains of persons who had lost a limb for a considerable time, that certain portions of the brain itself are either atrophied or deficient, the loss of different limbs evidently causing this deficiency in different parts of the brain. This goes far to prove that there are

separate portions of the brain for different duties, and the neglect of any one part causes atrophy or death of such part if continued long enough.

Insufficient nourishment also, or improper use of the nervous system tends to disorganise its functions.

It is but right, therefore, that the nervous system should be cultivated as much as any other part of the body, and naturally the proper method must be exercise, mental and physical.

This chapter has simply been introduced in order to show the inseparable connection between nerves and muscles, mind and matter, and to give the reader a better idea of the ways and means whereby movements are produced.

CHAPTER IV.

MUSCULAR DEVELOPMENT.

THE development of muscle, and increased strength the accompaniment of such development, is usually a fascinating subject with the majority of young men.

This is as it should be, for is not the glory of a man his strength?

The British nation, always athletic, is noted for its so-called "sporting instinct," but of late years there has been, unfortunately, a tendency for the many to watch the few, as, for instance, a crowd of 30,000 at a football match where 22 players are engaged, or 20,000 persons gazing intently at Cordang the cyclist, crowding 616 miles into a period of 24 hours.

Would it not be better if these great crowds personally engaged in some manly and athletic sport (there are plenty to choose from), rather than spend Saturday after Saturday, in addition to evenings during the week, gazing at paid sportsmen?

Still, slowly and surely a rational system of physical education, having for its ultimate object the raising of the nation's physical status, is becoming the rule and not the exception.

The question is frequently asked—Why is it necessary to develop all the muscles, when *apparently* some are never used by the ordinary individual?

The answer to this question, although simple, involves a long explanation.

It must be distinctly understood that it is absolutely impossible to perform the slightest movement and in so doing use only one muscle.

To quote Lagrange—"In order to move the forearm the arm must be fixed to give a point of application. The arm itself must be supported by the shoulder and the vertebral column and the thorax; but the thorax and vertebral column being supported by the pelvis, and this in turn by the legs, the whole body is obliged to participate in the movement of the forearm. From head to foot, all the muscles participate in the most insignificant and most localised work."

In violent movements of the arms a man derives a great amount of the force employed from his legs. A boxer delivering a blow with his fist involves his trunk and legs in the movement, and in addition to the extra amount of weight thus added also transmits a portion of their muscular force.

Some exercises, then, produce development in a part of the body very far distant from the limb actually performing the movement, and in places the uninitiated would never think of looking for development. This is one reason for developing as far as possible all the muscles. There is another and even more important reason, however. Nearly all muscles have an antagonistic muscle generally situated on the opposite side of the bone and joint.

In every movement, more especially those requiring any degree of *fineness*, the antagonistic muscle plays a very important part.

This antagonism is absolutely necessary that such fine movements may be more directly moderated and controlled. Watch how precisely the skilful golfer strikes the ball with just sufficient force to score a hole; or, again, how carefully the cricketer measures the exact time to raise his bat to meet the ball coming with lightning-like rapidity straight toward him.

At the top of his upward swing he suddenly stops, reverses this movement, and strikes the ball with terrific force.

This power of directing movements is obtained by means of a skilful co-ordination of antagonistic movement, which in most cases requires a large amount of practice. It is of course sometimes instinctive and perfect at birth, and is more fully exhibited in the lower animals than in the human being.

As an instance, "the newly-hatched duckling does not require an apprenticeship to learn the art of swimming. Neither does the chicken fresh from the egg need instruction to lift a grain of corn with its beak."

The human being, who as time goes on is required to perform movements requiring great skill (or great *sense* on the part of the antagonistic muscles), must educate this sense, which is the feeling that enables us to prove the exact amount of force, and antagonistic force, to exert in order to perform any movement correctly.

"A disease called 'Locomotor Ataxy' is simply an inability on the part of certain nerve centres to give the muscles the impulse suitable for the required movement, or a deficiency of co-ordination of movement."

Riding a cycle, minus a brake, in city traffic is one of the best examples of co-ordination of movement: one must propel the machine swiftly forward, then quickly slow down by the movement "back-pedalling," owing to some sudden stoppage of the traffic; then, again, for some distance one must ride in that peculiar manner which seems to consist of "back-pedalling" with one foot and yet driving with the other, all the time holding the machine under perfect control. To do this and any other movement requiring antagonism of muscular strength, the muscles must be educated and consequently developed.

In order to make this co-ordination as perfect as possible, every muscle must receive a due share of exercise, and then, but not till then, will our every movement be graceful, easy, and "natural."

As explained in the chapter on "Physiology of Exercise," the more a muscle is used the more blood passes through it, and the more blood passing through a muscle the more nourishment absorbed by it, consequently a gradual increase in size must follow.

Care must be taken that muscular development is not localised. It must be as *general* as a perfect education should be. Why is the ordinary gymnast of the present day not like the statues we are accustomed to consider as types of manly beauty?

We notice that a man who has practised assiduously for years on horizontal and parallel bars has in every case a most exaggerated development from the waist upward, particularly the shoulders, biceps, and chest.

The legs (which from their proper office being to support the whole body should be larger) are proportionally smaller than the upper half of the body.

The reason is obvious, since the arms have been made to play the part of the legs to too great an extent, by supporting and suspending the body on the hands too frequently.

The back is also somewhat rounded, and the shoulders drawn forward and downward.

The chest proper is rather inclined to be flat, although the exaggerated development of the "Pectorales" gives a false appearance of prominence, which is, however, not due to the arching of the ribs.

These deformities are noticeable in many of our prominent gymnasts who practise the old style of gymnastics to excess.

Fencing if carried to excess also tends to deformity, &c., by curving the spine laterally.

Riding sometimes produces slight curvature of the femur or thigh bone, and causes the horseman to become somewhat "bow-legged." "A jockey will develop a decided forward spinal curvature, as in his endeavour to lighten the weight on the horse's hind-quarters, he leans forward, and in holding up the reins he supports a weight which still further draws the spine forward."

Rowing, if practised assiduously, tends to develop the "pectorales" and the "latissimus dorsi" muscles

unduly, and spoil the figure. In fact, it is impossible to specialise all the exercises which tend to produce deformity, as any one exercise carried to excess may cause this.

In a course of training for *general* muscular development, two points must be guarded against—

1. That the work is not localised, or confined to a certain set of muscles too frequently or too long.

2. That movements which require the use of muscles not frequently called into action in every-day life are not worked too hard at first.

The very best exercises for general development are Ling's Swedish movements; the simple dumb-bell movements recommended by Sandow and contained in his book on "Strength." As the body is supported on the legs or back during these exercises, the vertebral column is unable to assume incorrect curves in maintaining a balance.

The great disadvantage of these kind of exercises is that they are not too attractive to a pupil who has merely to give a passive obedience. By means, however, of a system known as Free Gymnastics —which is the military and an Anglicised version of Ling — the somewhat monotonous round of dumb-bell exercises may be varied and the pupil interested.

As this work does not pretend to contain a *system of exercises* for development, only a few movements are here given, which, however, are the fundamental principles from which all so-called systems are derived.

The necessary apparatus is two pairs of dumb-bells, their weight being according to the table to

be found in the Appendix, and a pair of Indian clubs of 1 or 2 lbs. weight, according to sex or age.

The muscles used in each "exercise" are named therein, and reference is recommended to the chapter on the "Muscular System."

It is better to hold something in the hands whilst at exercise, because one feels that unless a slight weight be lifted, the work soon becomes irksome to a degree, as would any *apparently* unproductive labour.

This feeling of wasted exertion will present itself slightly in any case, but in a far greater measure if we be empty-handed, for most of the work performed by dumb-bells is to a certain extent monotonous, which monotony can only be overcome by looking steadfastly toward the goal of our exertions, viz., health and strength.

Another reason for grasping something in the hand during the exercises is that there may be a demand for full muscular contraction, which there would not be unless some weight is added to the weight of the limb to be moved.

The dumb-bells must neither be so light as to add really nothing to the mere lifting of the limb nor so heavy as to prevent rapid movement when necessary.

Some years ago, heavy bells were everywhere used. Recently, however, it has been discovered that fairly light bells give much better all-round results.

The continued use of very heavy weights is calculated perhaps to increase strength, but makes the user much slower in his movements.

For movements of the head and body in many instances nothing is required in the hand, and for more complicated exercises a special pulley apparatus may be desirable.

We will commence our Series of Exercises then in the same order as the muscles have been taken, beginning at the neck.

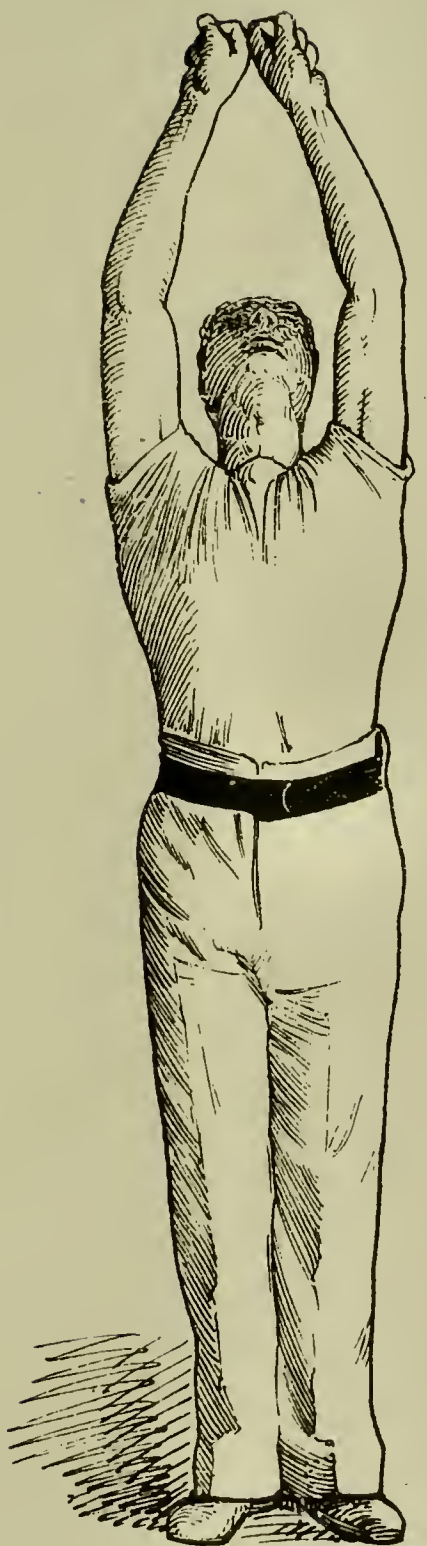
Reference should occasionally be made to one or other of the anatomical plates, in order to ascertain the exact positions of the muscles used in the exercises.

Exercise No. I.

Muscle 1.—"Sterno-cleido-mastoid" also "Trapezius."—Standing with the heels closed and toes turned out at an angle of about 45 deg., knees braced back, and chest advanced, commence by turning the head right and left slowly, but with a certain degree of force, as far as possible, in each direction about ten times. Bend the head forward and backward a like number, and lastly ten times more sideways from right to left as if to lay the ear on the shoulder. A combination of these movements may be made by rotating the head slowly first round to right and then to left.

Exercise No. II.

Muscle 2.—"Deltoid."—Stand in the position described above (known as "attention"), and, holding the pair of dumb-bells tightly, raise a certain number of times sideways over the head until the



EX. 2.

backs of the hands nearly meet, varying this movement by alternately swinging first the right and then the left hand to the front and above the head, keeping the arm straight.

Exercise No. III.

Muscles 3 and 18.—"Pectorale major," "Serratus magnus."—Raise the hands to the front in line with the shoulders, alternately, lowering right and left hands towards their respective thighs in front, varying this movement by carrying the hands towards the opposite hips sometimes. The right hand may complete the downward and upward movement before the left commences, or the hands may follow each other. Care must be taken that the bells are grasped firmly, and that the hand is *pressed* down to the thigh or hip and not simply lowered there. Repeat ten times with each hand.

Exercise No. IV.

Muscles 4, 5, and 6.—"Biceps," "Brachialis anticus," Triceps."—Stand at "attention," grasping the bells firmly as before, the finger nails toward the front of the thighs. Bend the arms, alternately, from the elbow, forcibly and slowly until the back of the hand is as near as possible to the breast. This is called flexing the arm, and the *biceps* assisted by the *brachialis anticus* are here at work; extend the arms again, bringing the hands to their first position, not, however, *dropping* them, but *pressing* them down to it. The extension of the arm works the "*triceps.*" This may be varied on

alternate days by bending the arm till the finger nails are against the breast.

Exercise No. V.

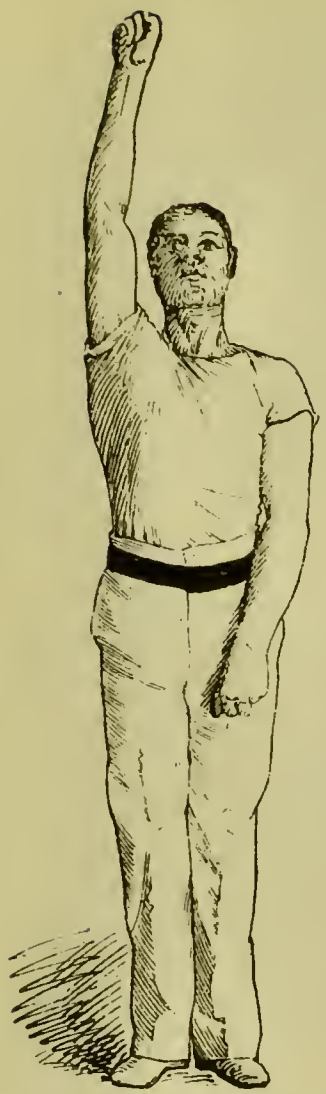
Muscles 7 and 8.—"Deltoid," "Supinator," and "Pronator" of forearm, also lowest part of Biceps. —Hold the arms out to the front in line with the shoulders, and working together turn the hands first upward then downward (supination and pronation), repeat about twenty times, taking care that the hands are turned in each direction as far as possible. This exercise may be varied, by holding the hands in line with the shoulders sideways or outwards, when the deltoid will receive more work in its posterior portion.

Exercise No. VI.

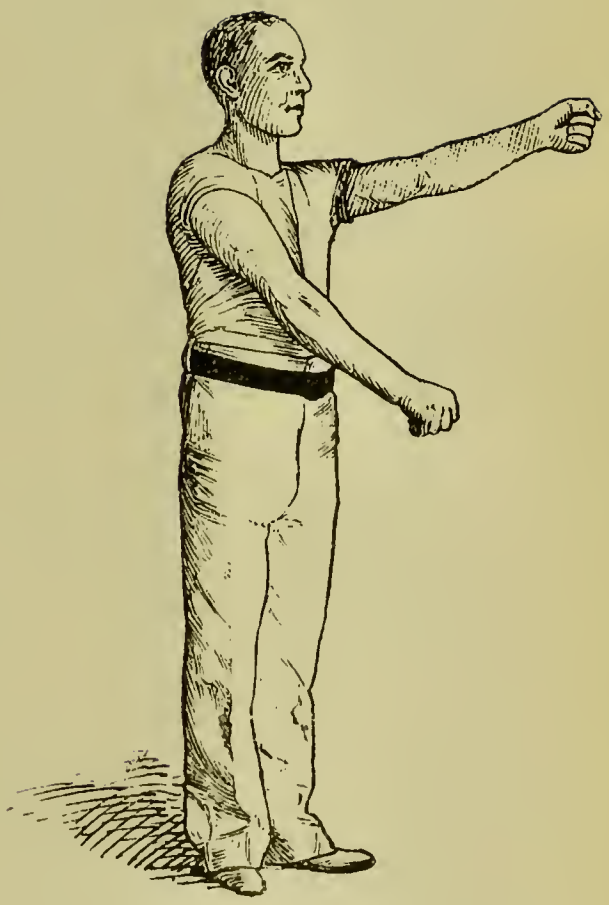
Muscles 9, 10, 11, 16, and 17.—"Flexor carpi radialis," "Flexor carpi ulnaris," "Palmaris longus," "Extensor carpi radialis," "Extensor carpi ulnaris."— Flex the arms at the elbows until the forearm is at right angles to the upper, and in this position bend the wrist upward and downward, and sideways, finishing the exercise by rotating the hand and making a combination of these movements until the forearm is fatigued.

Exercise No. VII.

Muscles 18, 21, 24, and 25.—"Serratus magnus," "Trapezius," "Teres minor," "Infra spinatus."— Indian club exercises, and swinging movements of the arms, with head erect and chest expanded.



EX. 2.-2ND PART.



EX. 3.

Exercise No. VIII.

Muscles 19 and 20.—"Obliquus extensor abdominis," "Rectus abdominis."—Lie down at full extent upon the back, hands placed upon the hips. Raise the body without assistance to a sitting posture, and repeat at least six times. If unable to raise the body, assistance in holding the feet down may be obtained, but practice will bring the strength necessary to accomplish this somewhat difficult movement.

Exercise No. IX.

Muscles 22 and 23.—"Latissimus dorsi," "Teres major."—The best way to develop the "latissimus" is by either boxing, swimming or fencing. For children and ladies, however, a similarity to the movements required in these exercises may be obtained by standing with the feet one in advance of the other and leaning slightly forward; then commence striking out, alternately right and left, about the height of the face, drawing the hand well back each time. This movement, which also exercises the triceps, should be repeated with the other foot advanced.

As an alternative exercise, the arms may be swung backward and forward as far to front or rear as possible, instead of striking. Repeat each about twenty times.

Exercise No. X. (*A*).

Muscles 26 and 30.—"Gluteus maximus," "Pectineus," also "Gracilis."—The three first-named muscles rotate the leg outwards and perform the first part of the following movement. Stand on

the left foot, retaining the balance unassisted, carry the right leg to the rear, leaning slightly forward in so doing, then carry sideways to the right.

Exercise No. X. (*B*).

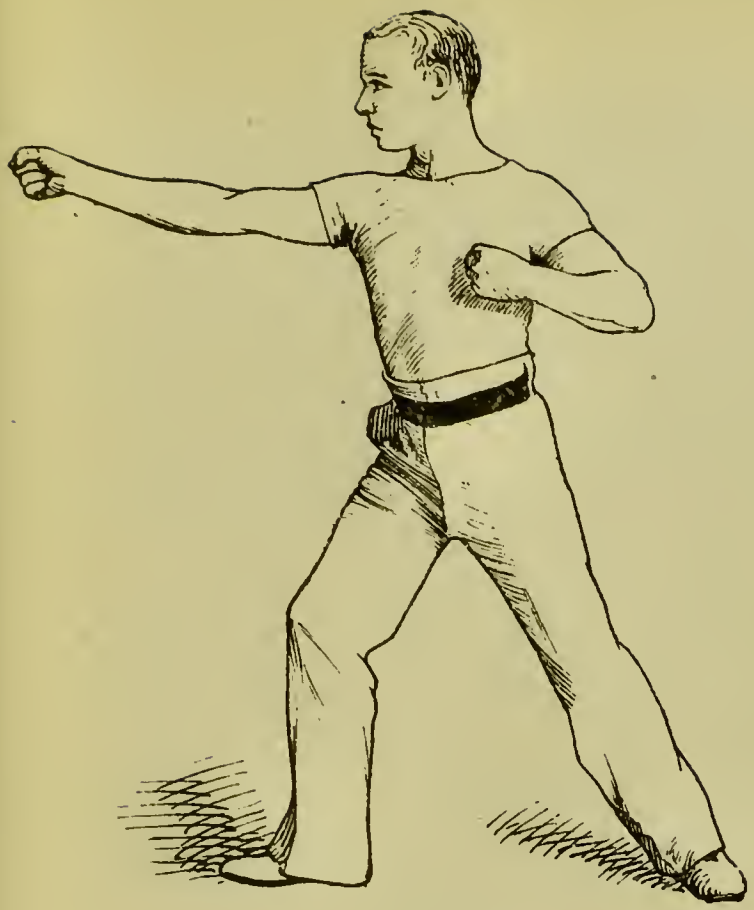
Muscles 31, 32, 33, and 34.—"Sartorius," "Adductor brevis," Adductor longus," "Gracilis."—The second part is performed by the muscles named, and consists in rotating the leg through the unfinished half of the circle, viz., to the front and back to its original position. This movement must be made in as nearly a circular manner as possible and repeated with the left leg, the leg being raised as nearly at right angles to the column of the body as possible throughout the whole movement.

Exercise No. XI.

Muscles 27, 28, and 29.—"Rectus femoris," "Vastus externus," "Vastus internus."—Stand on the toes with hands placed on the hips, chest advanced, heels together. Sit slowly down, as nearly as possible upon the heels, forcing the knees apart in so doing. Now extend the legs again which brings one back to the first position; repeat this movement several times.

When a certain amount of ease is found in performing this exercise, it may be made harder by causing one leg to do all the work as follows:—

Muscles 35, 36, and 37.—"Biceps femoris," "Semi-tendinosus," "Semi-membranosus." Raise one foot from the floor *to the front* and gradually sink to a



EX. 9.



EX. 9.- 2ND PART.

sitting posture on one heel, keeping the other foot clear of the ground. Then without assistance extend the leg, resuming the former position. Repeat about three times, and with both legs. This latter movement will be found very hard, the amount of work performed by the "quadriceps extensor" in a man of average weight being equal to over 200 foot-pounds in each extension.

Exercise No. XII.

Muscles 38, 39, and 40. — "Gastrocnemius," "Soleus," "Plantaris."— Stand at "attention," and commence the exercise by alternately rising on the toes (standing on tip-toe), and sinking on the heels, repeating this movement at least twenty times.

Exercise No. XIII.

Muscles 42, 43, and 44.— "Tibialis anticus." "Peroneus longus," "Peroneus brevis."—This exercise may be performed by sitting in a chair and flexing, extending, and rotating the foot in every possible direction. These muscles are situated on the front of the leg.

The foregoing exercises can be added to and varied to suit the taste and avoid the monotony of repetition. They, however, contain the fundamental principles of all the movements in what is termed "Swedish and Physical drill," and with the other exercises given here are sufficient to develop every muscle in the body.

To give the body suppleness, and the muscles a certain degree of elasticity, it is at times desirable to do the opposite of contracting them, viz., stretch

them. The following exercises will have this effect on the muscles about the trunk of the body, at the same time exercising their antagonistic muscles.

Exercise No. XIV.

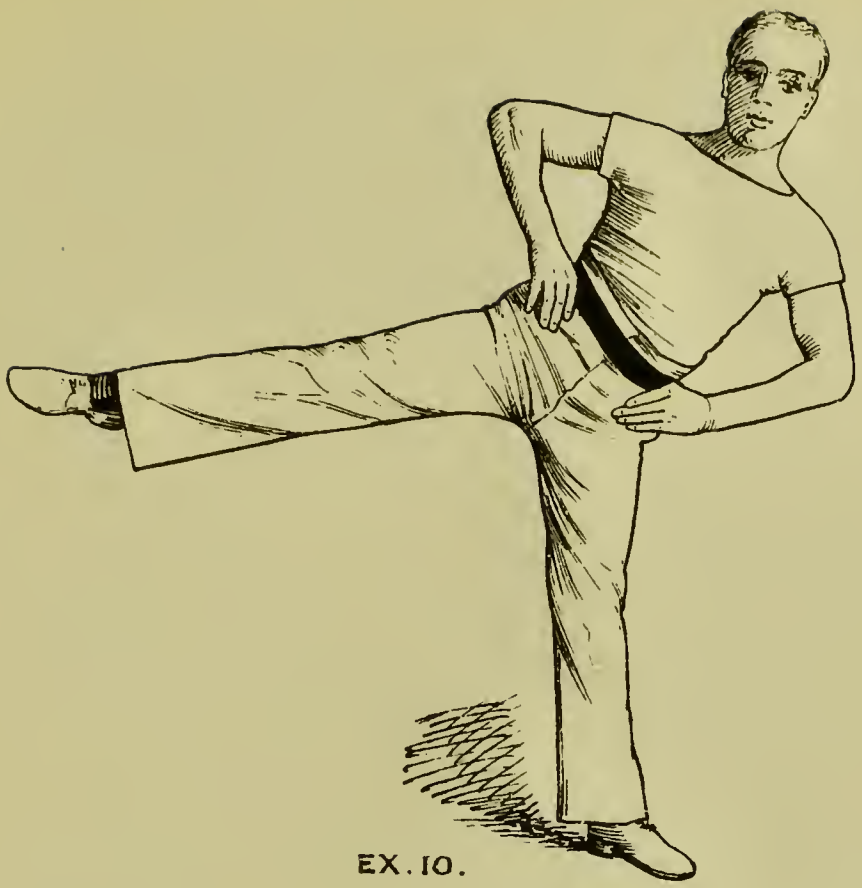
Muscles 18 and 19.—"Serratus magnus," "Obliquus externus abdominis."—Stand with the feet closed (both toes and heels) and legs braced back; place the hands on the hips; commence turning the body right and left as far as possible without bending the knees or moving the feet from the floor.

Exercise No. XV. (*A*).

"Serratus magnus," "Intercostales," "Abdominal muscles."—Stand with the feet twenty inches apart; hands raised to the full extent of the arms over the head; then bend the body right and left as far as possible, without raising the feet from the floor or bending the knees, and taking care to keep the arms relatively in the same position, viz., extended, and at the width of the shoulders.

Exercise No. XV. (*B*).

With the hands and feet kept in the same position, bend the body forward and backward. The forward bend will stretch the group of muscles known as "*erectores spinæ*," and if this movement is continued until the fingers touch the toes or the floor a similar effect is had on the muscles at the back of the thigh. The raising and backward bend exercises the "erectores spinæ" and stretches the "rectus" and "obliquus abdominis."



EX. 10.



EX. 11.

Exercise No. XVI. (*A*)

Jumping, both high and long, should be practised in order to give the leg muscles (more particularly Nos. 27 and 28, also 38 and 39) the necessary spring and elasticity.

Exercise No. XVI. (*B*)

The exercise known as lungeing, used principally in attacking in boxing or fencing, is a very fine exercise for the "*quadriceps extensor*" and muscles forming the calf of the leg. It is performed by stepping out to the right (a full pace of about 36 inches for a tall person) with the right foot, keeping the left leg straight, and left foot flat and firm upon the floor. The right knee must be bent and toe turned in the same direction as the lunge has been made, the feet being kept at right angles to each other, and the heels in line. To recover the position of attention, press strongly with the front of the right foot, and extending the leg, resume the position of attention.

Repeat at least 20 times and with each leg. For this exercise the hands may be held on the hips, fingers to the front, thumbs behind, elbows pressed backward, the breast advanced, and head held erect.

There are several apparatuses in the market for home training, and if one cares to invest in any one of them they will add a certain amount of variety to the work. The "Home Exercisers" known as the "Whiteley" and the "Sandow," are both very

good and simple machines and calculated to give satisfaction if used consistently. The swinging of Indian clubs should be learned under the tuition of an instructor, and is a very pleasing variety of exercise.

A careful study of the foregoing movements and muscles concerned therein will be found of great advantage in the use of any of these apparatuses.

It is essential and also makes the work *seem* of more use if we know on what muscle a certain exercise will take effect and it is interesting to watch and note the growth of that muscle.

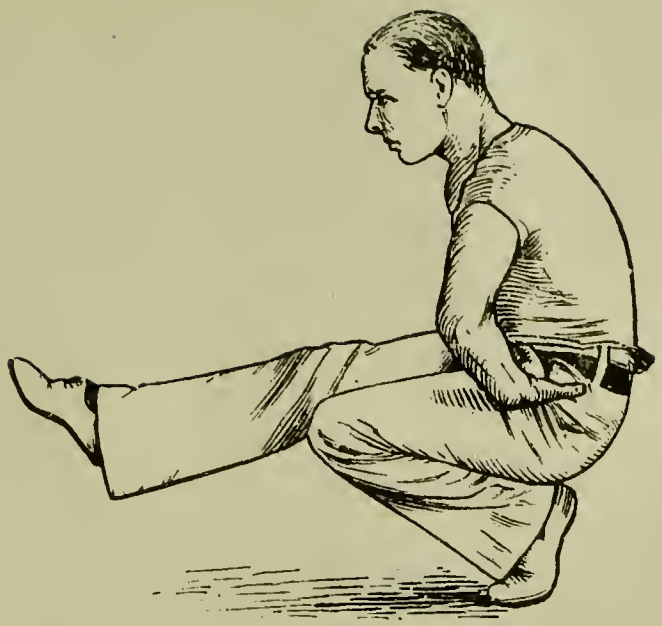
An exceedingly good plan is to carefully measure our arms (fore and upper), thigh, calf, waist, chest and neck before commencing a course of home training, and take such measurements monthly, for which purpose a specimen table is inserted in the Appendix.

The increase will be found much greater after the first six months of a year's training than the second, as one cannot go on developing for ever.

"The great thing in a course of home training is to derive a 'general benefit' from the work performed in the limited time at disposal," and the exercises given in this chapter have this primarily as their object.

Any special development of the limbs must be obtained by special means. If the arms are required to be particularly strong, then either gradually increase the weight of the dumb-bells, or practice the more arduous feats taught in the Gymnasium.

If it be the legs we are to develop, train them according to the sport they are to take part in.



EX. II.– 2ND. PART.



EX. 15.

To develop the muscles of the—

Chest, Legs, and Back,	Rowing, Football.
Right Arm and Legs,	Fencing, Cricket, Racquets, Tennis.
Chest, Back, Abdomen, Arms, and Neck,	Gymnastic Exercises on Horizontal Bar, Rings, Trapeze, Climbing Ropes.
Legs,	Gymnastic Exercises on Pommelled Horse, Pair Rings, Cycling, Running.

To those who can afford the necessary time and money, the two finest forms of exercise for summer, are undoubtedly cycling and rowing; for winter, gymnastics and football.

Cricket, golf or lawn tennis, may all have their special supporters, and it cannot be denied that these sports have good recommendations.

But even though all are good, none are perfect. Maclaren says "There is no single exercise, invented or 'inventable' by man, which gives employment to more than a part of the body and a very small part too, when closely examined." Now we have mentioned gymnastics as *an* exercise, which is not strictly correct, for it is essentially a *series of exercises*, which can be made to closely represent a number of various sports and games. The value of walking is not sufficiently appreciated by everyone; though it is a recognised fact that at least nine miles should be covered daily, more especially if it be the only exercise taken.

Walking, which is one of the finest exercises man is capable of, should greatly assist in developing the

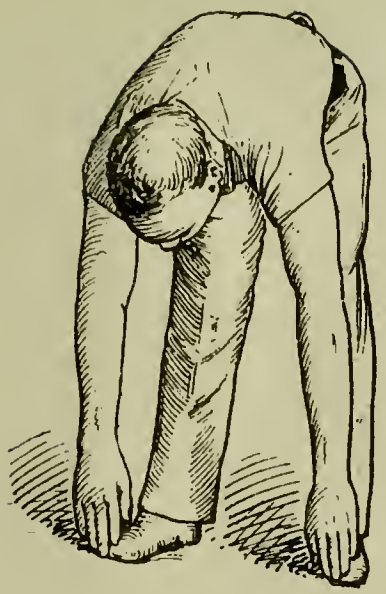
chest and lungs, but to do this great attention must be paid to the position and carriage of the body. The head must be held erect, (which in itself tends to elevate the chest), the shoulders held back, and the back hollowed out slightly. A free swing of the arms should be cultivated which assists the forward movement. Each step must be made firmly, and the foot should leave the ground with a slight backward pressure, the leg swinging well to the front from the hip.

The habit of walking correctly is somewhat difficult to acquire, and should be learned in a class at the gymnasium in much the same manner as the steps of a dance.

In rowing the principal work falls on the muscles known conjointly as "*erectores spinæ*" those situated at the loins and hips and on the extensor muscles of the legs. The muscles of the arms have very little work to do except those of the forearms. The great drawback to rowing is that it somewhat tends to contract the chest, but this drawback is almost made up for by the fact that during the exercise, the lungs inhale a large amount of oxygen, and are therefore assisted in their development.

Cycling also unfortunately tends to contract the chest somewhat, and does not give any employment to the muscles of the trunk, with the exception of the "*sacro lumbales*" and the "*erectores spinæ*," situated in the hollow of the back. The legs and principally the group of muscles known as "*quadriceps extensor*" do the largest share of work.

If however, these two forms of exercise be taken together and neither to excess, an almost ideal



EX. 15.- 2ND PART.



EX. 16. - 2ND PART.

combination is obtained. This is of course on the presumption that some early morning exercise in the shape of dumb-bells or punching ball, &c., is indulged in, for this exercise should never be missed.

For the winter we have mentioned gymnastics and football, the latter of which undoubtedly has its value for young people; and in fact the only objection to it is the risk of accidental injury.

In gymnastics we have an almost ideal form of recreation.

In all modern gymnasia the following subjects are taught—Fencing, boxing, jumping, climbing, musical, physical, and Swedish drills, and the apparatus work, such as horizontal bar, parallel bars, vaulting horse, rings, &c., which with the addition of the usual running and marching drill are assuredly sufficient to develop every muscle in the body.

There is one great disadvantage in every system of general or home muscular training which has been noted before. I refer to the monotony of repeating the same movement day after day, and although many are the arguments urged against gymnastics as taught with apparatus, still monotony is not, or should not be one.

Under a careful and well-trained instructor the deformity often caused by self-instruction will not be produced, for the exercise will be light and varied; the lower limbs will receive a full share of the work given, and a more all-round development will be the inevitable result.

Gymnastics as a means to an end is possibly the best exercise or series of exercises that can be taken,

especially during the six winter months. It is the abuse of certain apparatus, which has produced the outcry against gymnastics from so many prominent physical educationists.

There is a fascination to the learners of the various exercises, "tricks" as they are called, which is barely excelled by the golf "mania," or cycling "fever."

The apparent infinity of different movements to be learned and invented, adds largely to the interest and helps greatly to sustain it.

If fencing be learned, then lessons in boxing should also be taken, for in the former one stands right foot foremost, and in the latter with the left. Equal exercise is thus given to both sides of the body and equal quickness and strength to both arms.

As an indoor exercise, gymnastics rank first, and provided plenty of fresh air be admitted into the room, should equal many outdoor exercises.

Hoffmann says "We hold that education to be complete should include a two years' course of thorough gymnastic instruction, and without having undergone such a training no young man or young woman is fully equipped for the battle of life."

A large number of men when commencing a course of physical training are in a great hurry to be strong. They wish to be able to raise great weights, and to imitate the feats of Sandow. "Before all things, remember that strength comes gradually, and to some very slowly."

The lifting of heavy weights is certainly a fascinating branch of athletics, and the liking grows on one, but it has tc be learnt slowly, and the strength

gradually built up, or the result may be a strain of some vital portion of our machinery, which can never be cured.

To those, however, who have a fancy for this branch of athletics the following hints may be acceptable.

If the practice is to be done at home, procure a strong wooden platform to allow for accidents in the dropping of a weight, &c.

When buying dumb-bells and barbells see that they are made so that the weight may be gradually increased, either by filling the hollow ends with small leaden shot or by fixing additional iron plates of about 10 lbs. weight at each end. Start by practising simple movements with one or both hands, with not more than a weight of 30 lbs. until one finds that these movements are made with comparative ease; then increase by ten lbs. say, and repeat the same exercises. Remember that the body and legs must be strong as well as the arms (a point often forgotten).

A man may be termed "strong" when he can without discomfort raise with both hands 120 lbs. above his head, and support it there with one hand. If he can attain the strength to perform this feat, he may consider he has "crossed the line."

Be careful not to attempt a movement obviously beyond your known power, and do all movements cleanly and without sudden jerks. If for any reason one desires to specially develop individual sets of muscles it is necessary to select those forms of exercise which will achieve the desired results.

Muscular development is sometimes a hereditary tendency, for some develop in muscular bulk to an

extraordinary extent, and they are in most cases descended from muscular progenitors.

Exercise, however, always increases the size of muscles, though there will undoubtedly be a finality of increase.

In the appendix a table is given showing the rate of increase of three different types of men who carefully performed the exercises laid down in Sandow's book "Strength," for a period of six months. The youngest man made a simply marvellous all-round increase in size, and his weight increased by over 14 lbs.

If muscular development is taking place normally and with really good results the whole system benefits thereby. The step becomes lighter, the eye brighter, and a greater joy is felt in the mere fact of living.

CHAPTER V.

THE PHYSIOLOGY OF EXERCISE.

IN Chapter II. we have seen that the muscles subject to the nerves are the immediate cause of movement.

Few realise, however, what happens in our body when even the slightest movement is made.

The lifting of a finger or the closing of an eyelid creates a chemical action giving rise to certain phenomena which are ever present during life.

In the first place the blood flows more quickly in the muscles used, also (in a lesser degree), throughout the whole system, and secondly, the chemical action referred to causes the tissues of the muscles performing the movement to decay and die, and become merely waste material.

Now the blood has two principal and important functions. One is to carry with it on its ceaseless current certain nutrient properties to replace the effete and useless matter, and the other is to carry away on its return journey to the heart and lungs some of this waste material, which is then given off in the form of carbonic acid.

Our whole frame is composed of an enormous number of minute atoms each of which is born,

performs for a short period the work allotted it dies, and is then removed from the system in various ways which will be explained later.

There is therefore a continual process of birth, and death and removal going on amongst these atoms, and in this order we will consider these processes.

The atoms which in the aggregate form the living, breathing body, are replenished or even brought into existence by means of the nutritive system, whose organs convert the food we eat and digest into blood, which contains, (or should do so), all that is necessary for the replacement of the dead and consequently useless material. The blood is carried by minute channels (capillaries) into every part of our bodies and the nutriment it carries is there assimilated, by some as yet unexplained means, by the different parts of the body according to their many and various requirements.

This law of renovation is always (during life) in unceasing operation and thus the body is built up ready for the process of disintegration and decay.

The decay takes place because of a combustion of the tissues caused by movement. Even so slight an act as the lifting of a finger, nay even the operation of the nerves, the act of thinking, causing an incomprehensible change; and it is this change which constitutes the decay and death of the innumerable atoms composing our bodies.

Immediately an atom dies, it becomes useless to us and should be removed in one of three ways—as *carbonic acid* through the lungs, as *urea*, &c., through the kidneys, or as *sweat* (composed principally of

acetic, formic, and butyric acids with about 2 per cent. of solid matter) through the pores of the skin.

The first and last processes, viz.,—the *birth* and *removal* of these atoms, are to us the most important, for we cannot alter the fact of their decay and death, but we can very materially assist in removing and regenerating them.

Given a regular and sufficient amount of work and due attention to the simple rules of cleanliness, the removal of these dead, consequently useless and sometimes injurious, materials is carried on naturally and without discomfort or trouble to the system generally.

If, however, by being long in a state of idleness and inactivity we permit the system to become clogged with an undue amount of waste and effete material great discomfort is felt at any unaccustomed exertion.

"From the same cause also a dangerous strain is not infrequently put upon the heart, enfeebled by reason of its not having been stimulated by means of exercise to healthy and vigorous action."

The cause of all this is not far to seek. The combustion of the tissues is not absolutely perfect, for we find that a residue is left behind in the shape of carbonic and lactic acids, urea, &c.

Without a sufficiency of exercise the tissues become over rich in carbon and uric acid, the first of which under unaccustomed exercise generates an *excessive* quantity of carbonic acid, the latter causing some form of rheumatism.

The carbonic acid under ordinary circumstances is conveyed by the blood-vessels to the lungs and then given off by means of respiration. The heart

and lungs, however, because of an inactive life, are by no means of normal strength, and they thus have great difficulty in keeping pace with such an excessive production of carbonic acid. The first symptoms of distress, occasioned by hard and unaccustomed labour, and sometimes by quite an easy task, is usually that of "breathlessness," caused by the effort of the lungs to dispose of the carbonic acid which they cannot retain.

This breathless condition is usually only noticed in elderly or stout persons, (though occasionally among younger persons who do not take a sufficiency of exercise).

Let us consider a very ordinary case. A man whilst rather out of condition, his occupation being possibly of a sedentary nature, undertakes a walking or a cycling tour, and during the first day travels too far. He finds that on returning for the night, though he feels no immediate distress, he is "too tired to sleep."

He rises next morning with headache and stiff in every limb, and cannot possibly undertake exercise that day. Why is this?

It simply means that he has, through an excess of exercise, charged his blood with an abnormal quantity of waste, in the form of uric and carbonic acid; and he must gradually eliminate these disturbing elements from his system by means of gentle and easy exercise, perhaps assisted by a hot bath, when the tired and stiff feeling will gradually pass off, and he will be able to undertake *harder* work than before without the same inconvenience happening again.

But if he persist in defiance of nature's warning in overworking himself the fatigue will *not* pass off but will continue in a more or less acute form until he is possibly pulled up by a sharp attack of either gout or rheumatism. He stops his work, but the system still contains the excess products referred to, and cannot get rid of them, at all events for a considerable time, because the lungs, kidneys, and pores of the skin have sufficient to do in removing the *normal* waste products, and are not equal to removing such an excessive production. "This state is known as the 'fever of over-work.'"*

For the removal in a natural and certain manner of these principal waste products a *sufficiency* of bodily exercise is necessary, no more, no less.

Now, in addition to exercise being the chief agent in the decay of the tissues, it likewise, in causing the blood to circulate quicker, is the main factor in their regeneration, for the whole body derives its life and nourishment from the blood.

Those muscles which are most used decay fastest, but *there* also the blood circulates more rapidly, and leaves behind it the necessary material for new fibres.

Thus it happens that the right arm of a blacksmith is invariably larger than his left, or that the legs of a pedestrian or cyclist are more fully developed than his other limbs.

Lagrange, says—"It is a law of nature that the nutrition of an organ is in proportion to the quantity of blood which passes through it, and that every organ in activity draws a greater quantity of blood toward it than it does in a state of repose."

* LAGRANGE.

Although exercise is responsible for the *local* development, this is only one of its effects.

The lungs and heart also receive a share of this development, because the work of purifying and sending the blood throughout the body is performed by them. Consequently they in turn become strengthened, and thus we see that every movement and exercise taken rationally *must* have a beneficial effect throughout the whole body.

In fact, exercise is to every one an absolute necessity, for it is upon the mysterious processes of combustion and renovation that our existence depends.

A natural law of supply and demand, regulated with a mechanical exactitude is in constant operation in the animal system.

For the purposes of illustration, the demand may be considered as the movements required by us in every-day life, such as walking, running &c., and in fact any movement, physical or mental.

The supply to meet this demand is oxygen and food, which latter, however, we must remember, is but raw material, and like the wool on the back of the sheep, or the iron in the ground must undergo a variety of processes before being fitted for its ultimate purpose.

When the supply fails to meet the demand we say a person is starved, and when the supply is greater than the demand that person is overfed.

It is absolutely necessary to keep the balance as nearly as possible equal, and it is to a great extent in our power to observe that this equality be maintained.

"Each organ responsible for the removal of its particular 'pabulum' of decayed matter must be kept in a healthy condition" in order that the whole body may be healthy.

Although one organ may assist another (and the proper working of each system, and part thereof is necessary to the perfect working of the body as a whole), each must perform its own duty satisfactorily, for the lungs cannot perform the functions of the skin, nor the bladder the work of the lungs.

The word "digestion" so often occurs in conversation upon the foregoing matters that it is necessary to fully understand what it actually is, and the vital and important bearing it has on our life.

Digestion is closely allied to the absorption and diffusion of the substances necessary for replacing the decayed tissues, but an actual explanation of the process of absorption is at present impossible.

The laws which govern the attraction of those parts of food, each to their own particular place, are still unknown and therefore inexplicable.

That there is a fixed law of diffusion and absorption is known, as the result of experiments on animals, with various kinds of food, "the effects and actions of which are always the same, thus showing that the capability of absorption is not an accidental property."

By digestion then is meant "the series of processes, chemical and physical, by means of which the introduction of food into the vascular system for the replacement of the effete portions of the organs, and for the maintenance of life, is accomplished."

The principal chemical properties contained in food are as follows:—

NITROGENOUS COMPOUNDS, CARBO-HYDRATES, WATER, SALTS, AND FATS.

Nitrogenous or *tissue-building* food-stuffs are found in both animal and vegetable food, and are chiefly useful in building up the growing body and in repairing waste. For this reason they should form a large portion of the food consumed by growing children, especially boys. Nitrogenous foods contain two groups of substances, one called *proteids*, the other *gelatinoids*; the former of which when transformed by the gastric fluid are called *peptones* and are then absorbed into the system.

The principal of these proteids are "albumen, fibrin, musculin or syntonin; casein, globulin, and hæmato-crystallin."

Albumen forms a constant constituent of all those animal fluids which carry material for replacement of decayed tissue, and is the principal constituent of the *serum* of the blood.

Investigation has shown that it needs only very slight modifications to become changed into the *contractile tissue* of the muscles and the contents of *nerve tubules.*

Fibrin appears to be a prominent constituent of blood, and a product of the transformation of albumen, and is considered to become eventually a tissue material. *Casein* is contained in milk in fairly large quantities (as much as 17 p. c.), and is found in the blood in small quantities, when it is called *serum casein.*

It is also found in the *interstitial fluids* of muscles, and is supposed to constitute an important item in the exercise of their functions.

It is contained in (comparatively) large quantities in the yolk of the egg.

Musculin, or fibrin of muscles, is the most important constituent of the transversely striated muscles, and of the contractile fibre cells of muscle, and is supposed in common with casein to be necessary to the vital contractility of the tissue.

With the other two protein bodies, viz., globulin and hæmato-crystallin, we need scarcely concern ourselves.

The *Carbo-Hydrates* or *heat formers;* most prominent amongst these we find *grape sugar.* It is found pre-formed in many articles of food, and many other carbo-hydrates must be converted into it before they are absorbed, or otherwise transformed. Grape sugar is principally and in great part absorbed by the intestinal capillaries within $1\frac{1}{2}$ hours after its inception, and is then found in the blood in almost a pure state, and in large quantities.

Starch, contained in most grain foods, potatoes, &c., is not absorbed into the system as such, because it is insoluble, but when boiled and mixed with saliva during mastication, it eventually turns into *sugar* and *dextrin* after being operated on by the gastric fluid.

"*Dextrin*" is only found in the intestine in very small quantities, and probably changes into sugar very soon after.

Gluten, or "*Gum*," penetrates animal membranes with greater difficulty than most substances, and direct experiments have afforded the result that it

is passed off practically unabsorbed and is thus not an essential element of diet.

"*Cellulose*" is a substance insoluble in all ordinary chemical solvents and in all known digestive fluids, and is consequently held to be unfit for digestion.

Salts, of which several kinds are found in the system, are an absolute necessity to the maintenance of health and good digestion. The principal are *common salt* or *chloride of sodium, salts of potassium, lime* and *magnesia;* the lime salts are most necessary for children, in order to form bone, and are to be found in large quantities in milk.

"*Fats*," of which there are several kinds, appear to enter the blood in small quantities and in a pure state, without undergoing any precise change of substance. The saliva and gastric-juice have no influence upon it. Fatty tissue is dissolved in the stomach and eventually becomes a granular matter which, however, is still fat, though very finely divided.

Now, though fat is insoluble in water, it passes through the animal membranes which are moistened with this fluid, and it has been found that it is the *bile* which renders it possible for fat to pass through these membranes into the blood.

Our daily food contains the foregoing properties, more or less, and it is the duty of our assimilative organs to diffuse and absorb them to the requisite extent, and pass the remainder from the body as being of no use, these processes being known collectively as digestion. Exercise has the effect of assisting digestion in a marked degree, and is in fact the main agent in the maintenance of an equal balance between supply and demand.

So much then for the manner in which the various atoms composing our bodies are brought into existence.

The values of various foods are more fully considered in the chapter, "Hints on Training and Diet."

Let us now consider more closely the various means by which those atoms, which have performed the work allotted them, are, when no longer required, removed from the system. In health, the various systems of the body work so harmoniously with each other that we are apt to forget the important, though perhaps entirely different, functions each system must satisfactorily perform if that health is to be maintained.

As before mentioned, there are three great channels of elimination, viz., the lungs, the pores of the skin, and the kidneys; and in this order we will consider them. The important connection existing between exercise and this subject will be immediately recognised by the fact that any unaccustomed exertion means an increased rate of respiration and a greater perspiration. The lungs, which are two in number, are really a collection of elastic and very distensible bags, which communicate very freely with each other as well as with the outer air. They are divided into *lobes*, the right lung containing three, and the left two; these *lobes* are subdivided into *lobules*, which are the little elastic bags before referred to.

The windpipe or *Trachea* eventually enters the lungs as the *bronchial tubes*, which are continually branching out from each other, at the end of each branch being a small cluster of air cells. The

membrane of these cells is intersected with innumerable capillaries called *pulmonary* capillaries, which are full of blood, ready for oxygenation or cleansing, thus presenting a large area for the exchange of oxygen for carbonic acid, which is given up by the blood. The air cells are round, about $\frac{1}{100}$ of an inch in diameter, and smallest in the centre of the lung.

The lungs are contracted and expanded by various muscles. The muscles used in expansion are the *diaphragm* and *scaleni*, which increase the diameter of the chest vertically, the *external intercostals*, *internal intercostals* and *levatores*, which expand it laterally and increase its girth. When an abnormally large inspiration is required, other inspiratory muscles come into play, and by their combined action secure the necessary expansion of the chest.

The air is expelled from the lungs by means of the constriction of the visceral cavity caused by the muscles of the *abdominal wall*, the lower *internal intercostals*, the *sacro-lumbales*, &c.

The process of respiration consists mainly in an exchange of certain gaseous substances in the lungs, between the blood and the atmospheric air. When a draught of air is inhaled its oxygen is taken up by the blood, and in exchange is given off carbonic acid and a watery vapour. The amount of carbonic acid contained in the exhaled air depends greatly on the following conditions—Frequency of respiratory movements, sleep, age, sex, and amount of exertion.

When respiration is doubled (in speed, not depth) the amount of carbonic acid exhaled is much less than in normal respiration, that is, relatively, breath

for breath. During sleep the quantity is greatly diminished, but immediately on waking it again increases.

"The amount of carbonic acid exhaled increases up to the 40th or 46th year, principally with the development of the muscular system."

Proportionally, weight for weight, children exhale more carbonic acid than adults, and men more than women. During exercise, and for some little time afterwards, the increase of carbonic acid exhaled is most marked.

As the blood relies upon its supply of oxygen to carry out its chemical action upon the various properties it contains, it is absolutely necessary that the lungs should perform their duties thoroughly. The flow of blood to the heart is aided by the elasticity of the lungs. Now they cannot have the necessary elasticity unless the chest have a proportionate flexibility, and any exercise tending to expand the chest and quicken and deepen the respiration must have the effect of developing the lungs, at the same time giving them more room in which to expand. A healthy man should inhale about 30 cubic inches of air at a time, and about 20 times a minute, whilst standing or walking easily, thus inhaling approximately 600 cubic inches per minute. The respirations are slower when sitting or lying than when standing; and when asleep than when awake.

The greatest volume of air which an individual can inhale in one breath, is known as the "*vital capacity.*" The vital capacity of a man of ordinary height is about 210 cubic inches; of a woman, only 160 cubic inches.

Under the conditions of a sedentary life nearly one-half of the air cells in the lungs remain habitually contracted, and take scarcely any part in the act of respiration. These cells thus lose their elasticity, the chest itself becomes narrow and shrunken, and when a sudden call is made for a full and deep inspiration the lungs cannot respond satisfactorily. The same exertion which made a deeper inspiration necessary also caused a larger amount of waste tissue to be thrown into the blood, and with this greater production the lungs are unable to cope immediately.

The excess of carbon generated must, therefore, await removal until a greater amount of oxygen be inhaled; which is eventually managed by the respirations increasing in rate, causing the condition we have spoken of as "breathlessness."

There are several popular forms of exercise which, while developing particular muscles, also have the power to develop the lungs, which process is known as "getting wind." Of these may be mentioned, rowing, running, walking, cycling, football, and, lastly, gymnastics, which includes fencing and boxing.

We will next consider the skin, another medium whereby the waste tissue is removed from the body.

The skin, which forms the body covering, consists of two parts.—(1) The superficial layer or *epidermis*, which is of a scaly or horny character, and destitute of nerves or blood-vessels. It is this part which after scalds or burns becomes raised from the other skin by the formation of a blister. (2) The deeper layer or *dermis*, which is much thicker, is well supplied with nerves and blood-vessels. The great sensitiveness of the skin is due to the richness of its nerve

supply. The skin varies in thickness in different parts of the body, being thickest on the soles of the feet, palms of the hands, and the buttocks. Under the skin is a layer of fat in a fibrous network containing the sweat glands, each of which has a duct, which comes to the surface of the outer skin, and is then called a pore. There are also other glands known as *sebaceous*, which secrete an oily fluid, the constituents of which are *olein* and *palmatin*, which moisten the roots of the innumerable hairs of the body, and also keep the skin from becoming too dry. The sweat, or *sudoriferous*, glands secrete and exude perspiration, which is principally composed of *formic* and *acetic* acids.

A portion of the nitrogen absorbed by the blood from food is also given off from the sweat glands.

Perspiration, which is *constantly* being produced, is of two kinds, viz., sensible and insensible. The *sensible* collects in drops upon the skin, and is produced by exertion; the *insensible* is that which is constantly being produced, even when the body is totally at rest, and evaporates almost immediately.

The chemical changes on which the performance of work depends manifest themselves in the production of carbon and nitrogen, and as these are both constituents of perspiration, they increase in quantity as excreta, as muscular work increases. The skin, therefore, by means of its pores removes from the system carbonic acid, nitrogen, about 2 p. c. of solid matter, and formic, acetic, and butyric acids, which are chemical changes of tissue.

In order that the skin should be permitted to properly perform its most important functions, it should

be kept perfectly clean. This matter has been fully dealt with in the chapter on "Elementary Hygiene," under the heading of "Baths," and to it the reader is referred as being most important.

Waste tissue (or its chemical equivalents) is also removed from the body through the kidneys.

The principal chemicals here eliminated are:—*Urea*, *uric*, *hippuric*, and *formic* acids, *chlorine*, the *chlorides of potassium* and *sodium*, and small quantities of *urate of ammonia*. *Sulphates* are here constantly secreted, more particularly after violent bodily exercise or excitement. Traces of *iron* and *salicylic* acid are also to be found in healthy individuals.

Sufficient mention has been made of the various excretions and exudations of the body for the purpose of this work. It is enough that we know the effect that exercise has in causing the chemical changes from food to tissue, and from tissue to waste material, all of which changes may be summed up in the one word, "Life."

CHAPTER VI.

HINTS ON FOOD AND TRAINING.

THE various meanings of the word Training may easily be reduced to one, viz., "The adaptation of the organism to certain particular conditions of activity," or, as Zimmerman explains it, "the gradual fitting of the body to withstand new and unaccustomed strains."

Training also applies to the brain, "for we may as certainly believe that the brain of a professor of science differs from that of a hod carrier, as we are certain that the muscular conformation of a prize fighter differs from that of a student." The changes in the structure produced by training, however, are not very profound, nor in the majority of cases are they permanent; they are produced rapidly and disappear almost as rapidly.

Lagrange says—"All professions which demand a great expenditure of muscular strength maintain those who practise them in perfect *condition*." But let us suppose that a clerk, student, or anyone whose occupation is purely mental, wishes to enter for a race, a sculling match, or any athletic event requiring a fatigue-resisting power. Leaving out of the question

the special skill required, the strength, fitness, in short, the *condition* of body requisite for such a trial of skill and endurance must be obtained by some course of "*training.*"

Training may be natural, methodical, or severe, and may be accomplished in many ways.

A really severe course of training is rarely necessary or advisable except in extreme cases, as for instance where a man past the age of 32, and inclined to "*embonpoint,*" desires (for some reason) to enter an athletic contest again. In such a case, the training would of necessity be of a more severe character than that required by a younger and possibly more athletic man. An active and laborious life keeps a man in such a condition that it is scarcely necessary for him to observe the many and troublesome hygienic and dietetic rules laid down by most professional trainers.

Eugen Sandow, who without doubt is a magnificent example of muscular development and health, does not believe in training by fixed rule, nor in the strict regulation of diet. It must be frankly admitted, however, that the effects of work or training are much more rapid, when a well-regulated diet is adhered to, and when the bathing, as advised or preferred, is regularly performed. It must be distinctly understood from the first that to train does not necessarily mean to lose weight; on the contrary, a healthy young man will often gain some pounds, unless, of course, he was inclined to be stout before he commenced a course.

The following is a medical description of a man in good "condition," and will give a very clear idea

of what one should expect to find after a course of training, such as will be hereafter detailed.

. . . "The limbs have sensibly increased in size. The muscles are hard and prominent, yet elastic to the touch; they contract with extraordinary force under the influence of an electric shock. The abdomen is retracted, the chest expanded; breathing full and deep, capable of long efforts. The skin firm, sleek, and free from all eruptions; the eye bright, and the step firm and elastic."

Such then is the appearance of a man in good condition, and such must be the copy for one to take as *his* ideal when he commences training.

To bring an ordinary healthy man to this degree of vigour and strength, six weeks at least will be necessary. During this period a gradually increasing quantity of muscular work is performed with the twofold object of (1) developing his muscular energy; and (2) increasing his power of resisting fatigue.

It must be remembered that the different sports for which a man is training will make a difference in some of the rules regarding his diet.

A man training for a Heavy-weight Boxing Championship may increase his weight with impunity, in fact, with advantage, provided he does not put on fat; on the other hand, the oarsman must diminish his weight as much as possible, consistent with health and strength, in order to lessen the weight he will have to pull.

These different conditions, therefore, must be well weighed before commencing, and for this reason a scale of diet can only be prepared when one knows in what sport a man intends to compete.

In all cases during the first week or so a man should lose weight slightly whether he diet himself or not, because he loses a large amount of fatty tissue and his muscles have in so short a time scarcely begun to enlarge and so make up the lost weight.

Where loss of weight is considered necessary, it must be done during the first week of our six, that is to say, it must be the first stage. This loss may be obtained in several ways, one of which is as follows:—

Rise early, say 7 a.m., and take a medium dose of sulphate of magnesia, and walk a mile or two before breakfast. One or two hours after breakfast, walk 5 miles at a good pace clothed in three complete suits of flannel or woollen underclothing, &c. Take a cold shower bath immediately on returning while the perspiration is at its maximum, and retire early to bed.

Take this treatment every other day for the first week, say four times, and on alternate days just perform the usual work, taking care not to eat fatty food. Drink only a small quantity of liquid, and eat plenty of well-cooked vegetables.

In this way about 14lbs may easily be lost in 8 days, and even more if a Turkish bath be taken on the second day's training.

The foregoing scheme is only given as a guide to those who desire to lose weight and may be classed under the head of "severe" training.

One curious fact is well worth noting here. The odour of the perspiration exhaled by a man in perfect condition is not so unpleasant or so marked

as in persons of sedentary life who have casually undertaken some violent muscular labour.

The reason for this, however, is simple. The skin of the "conditioned" man no longer exhales the volatile fatty acids, which are the chief cause of the peculiar odour of perspiration, at all events, to anything like the same extent as from the skin of a person untrained and of sedentary occupation.

To a trainer, therefore, or a friend who constitutes himself the *masseur* for the time being, the gradual lessening of the marked odour of perspiration will indicate that the man is getting into form.

Physiologically, the trained man and the untrained man who has led a sedentary life must be considered as totally different units. Should we place these two in otherwise identical conditions in which they are called on to perform the same number of foot-pounds work, we shall find a much greater quickening of pulse and breathing in the untrained man. The air he expires will contain a larger percentage of carbonic acid, his perspiration will contain more volatile products and, in fact, he creates a greater waste of tissue and of strength than his trained friend.

Training, unfortunately, is too often carried to excess and to such a degree that many writers on the subject decry any fixed rules at all. Checkley says, "Muscle moulding schemes that make men die in middle life may be pictorially interesting, and may sound heroic, but they are not for that wise average mortal who wishes simply to feel light and strong and if need be find himself ready to safely enter on any reasonable physical undertaking."

This "heroic" kind of training brings the whole thing into bad repute and sometimes does actual injury. If the muscles are increased in size and hardened, and the actual health not built up at the same time, be sure something is wrong in the system used.

A training that does not educate and improve the whole wonderful and complex system of a man, and not merely his external muscles is and must be, on the face of it, *wrong*. A permanent strength cannot be built up from the outside, but when the lungs and heart are practically perfect, then is the time to look at our *biceps*.

Checkley truly writes:—"I am afraid there is a good deal more '*straining*' than 'training' in a good many popular systems in vogue in the present day," and certainly one word will perhaps be sufficient for all young men to bear in mind either when training or with regard to food or drink, viz., "*moderation*."

Although, owing to the different temperaments of men, hard and fast rules cannot be laid down for those desirous of training themselves, many who read this work may at some time wish for some hints on the subject. The opinions of various champions in their own sports are therefore submitted, together with a modified scheme, which the author believes will be found (with but few alterations) to suit all.

Sid Thomas, the champion cross-country runner, advises as follows:—"Rise about 7 a.m., have a cold bath and grooming with a rough towel before breakfast, and eat plain nourishing food, avoiding soups,

pastry, and anything indigestible. Tea-drinking does not agree with some. Cocoa I find better than tea in my own case. Smoking is fatal to the wind, and a man must learn to pass the public house without going in. Hot stuffy rooms should be avoided, and fresh air taken on every opportunity. Be careful not to run too soon before or after meals. Three spins of about five miles each week will keep most men in condition, though some require to run every day to show their very best. A man's own feelings must guide him in the matter, though, if you can obtain the advice of an experienced professional runner on the matter. Cultivate a good style, the knee brought up and well forward, and do not swing the arms across the chest. He runs best who runs easiest."

This seems to be an extremely moderate opinion, and if followed can do no harm, at all events.

To those intending to merely cultivate muscle, I offer Sandow's advice. Firstly, purchase his chart and system of exercise. Sandow does not believe in strict training or in any special diet. He drinks and smokes in moderation. His whole system is simple, and consists in performing certain exercises *regularly* every day, and in using every muscle of the body, and thus developing the whole muscular system both internal and external.

The weight of the dumb-bells used is *gradually increased*, as also the number of movements to be made, and to sum up he says:—"Be moderate in all things and you need fear no interruption in gaining strength by my system of training." Sandow also strongly recommends the daily cold bath (for all

strong enough), with the following curious advice :— "Don't spend any time over rubbing yourself dry . . . Get into your clothes without drying the body at all. The damp is carried away through the clothes, and no particle of wet is left."

The opinion of a world-renowned cyclist is surely worth having. Zimmerman says :—"It is advisable before commencing to train to consult a physician to see that you are perfectly sound, because if you are not it is folly to begin.

"Be careful as to diet, retire early and abstain from smoking and alcoholic drinks. Smoking depresses the heart, and shortens the wind, while drinking strains the blood. I do not believe in riding or doing any work before breakfast, but about one and a half hours after a good meal. Do the hard work in the morning; the fast work in the afternoon or evening. I would advise lots of hand-rubbing . . . as it benefits the muscles and works off lots of flesh. I do not advise a cold bath, but a salt water sponge bath in the morning is an excellent thing, rubbing yourself quite dry with a soft absorbent towel. Turkish and warm baths should be used with moderation. There is no question of the good to be got from regular gymnasium training."

These, then, are the opinions of three men all practically at the head of their own particular branch of athletics, yet, with some minor exceptions, all agreeing in the desirability of observing three principal points, viz., early hours, morning bathing, and moderation in food and work.

The subject of bathing is treated more fully in the chapter on "Hygiene," so that no more need be said

here on that head. Sleep also has been dealt with under the head of "Hygiene," but a few remarks on the physiology of repose will be of value. During sleep vitality is at its lowest point, or plainly speaking, at that time our whole organism is doing the least possible work, so much so, that sound sleep is often likened to death itself. The movements made by the lungs are slighter, and by the body practically *nil.* The production of waste product is therefore correspondingly lessened. "This being the case, rest is the essential condition for the elimination of waste caused by the work that *has been* performed, and also the essential condition for repair and assimilation of those tissues which are dissimulated during work."

If insufficient sleep or incomplete repose be obtained, two things happen—(1) Waste material is accumulated in the system, with attendant evils; and (2) The building up process is insufficiently performed. Many medical men believe that insufficient sleep is often the cause of stunted growth amongst our boys and girls. Insufficient sleep and incomplete repose also prevent the athlete from getting into a perfect "condition."

On the other hand, *cæteris paribus*, the work performed whilst training will ensure the healthy man getting sufficient repose, for the very simple reason that on his head touching the pillow he falls asleep and does not wake till he has had sufficient rest.

Roughly speaking, the man in training requires nearly nine hours' good sleep; the best time being from 10 p.m. until 7 a.m.

In attempting to formulate a scheme for training, one must consider the usual habits, temperament, age, weight, and business of the person to be trained.

If under the age of twenty, and of slight build, great care must be taken that too much work is not performed, whether the game be running, rowing, gymnastics, or cycling, &c. If the man be employed at a sedentary occupation, the work must commence easily, and gradually increase in severity. Then, again, some men are natural athletes, and scarcely require any training at all; some go stale at the most unexpected periods, though this is usually a fault of the trainer, owing to his inability to understand the temperament and consequent amount of work necessary.

Now, although a man should increase in natural strength until forty-five or so, it will be noticed that after twenty-eight more training is required to fetch a man to the pink of condition, than when at the age of twenty-two or thereabout. Every year after this age (28) the work becomes more arduous and a longer time is necessary for the training. There is one thing which refers equally to all, viz., that the work must be regular, for one day lost cannot be pulled up by doing twice the work next day.

The question of diet must be left in a large measure to personal liking and habits. Some of our best known athletes would have us believe that they eat and drink everything and anything that comes their way.

I feel quite certain, however, that a little self-denial is practised, and I therefore recommend that about a month before actual training commences the

following articles of food should be dispensed with—ham, pork, bacon, or the flesh of the pig in any form, the fat of all meats, potatoes, and an excessive quantity of bread. These are almost all the solids with the exception of pastry, which must be given up. As to what one should drink, I think *all* alcoholic liquors should be banished, but if one feels it a necessity possibly *one* glass of ale per day may not materially retard the work in hand. Tobacco, except for the most an occasional whiff, must be left off as it has a bad effect, when any quantity is used, on the heart and lungs. It is better that these articles of food and drink should be discontinued some little time before commencing work, in order to allow of the body throwing off naturally some of the superfluous adipose tissue, and save the trouble of working it down.

After rising in the morning, a half glass of *hot* water should be taken, and taken as hot as possible. This has the effect of thoroughly cleansing the stomach. As an alternative, a seidlitz powder two or three mornings per week, before breakfast, is a good thing. Your breakfast may consist of porridge and an egg or two; a couple of boiled eggs; a fried chop and an egg; some fish; or anything light and wholesome, together with a cup of good cocoa in preference to either tea or coffee. The chop should be divested of its fat, and the bread used must not be too thickly buttered. Some fat in the diet is a necessity, but plenty is contained in milk and cocoa, without taking too much in any other way.

Dinner, which should not be taken sooner than four hours after breakfast, may consist of a small

quantity of meat, not much more than 6 oz. (when cooked), with plenty of good vegetables, followed by dessert, which might be, say, stewed fruit, or rice, or other grain food, boiled. Cheese is not advisable unless in the smallest quantity. One glass of beer, if very much desired, may be allowed, but in preference a glass of claret or sherry should be taken, and would do no harm.

For Tea, at 6 p.m., a little cold meat might be eaten with toast, and perhaps one cup of tea.

For Supper, which should not be later than 9 p.m., some Bovril tea, or Bovril sandwiches, or, if preferred, a cup of good strong cocoa and a biscuit, is quite sufficient to retire upon.

Such a bill of fare though plain admits of plenty of variation, and the little self-denials imposed by observing the rules above, assuredly bring their own reward afterwards.

Sugar as a food has of late been brought into prominence and favour amongst athletes. A few years ago trainers would scarcely permit the use of sugar in any form; it was, at all events, considered advisable to limit its use to a very great extent.

Sugar, that is grape sugar, is now known to be a principal muscle food, and it has the advantage of being quickly absorbed into the system.

A drink containing from 10 to 30 per cent. of sugar has a really marvellous effect on the tired muscles. I have personally experienced the almost magical effect which follows in 10 minutes after its inception, and converts a tired and practically feeble man into one full of life and vigour.

For these reasons, grapes and champagne are two

of the most important nutriments given to our long-distance cyclists.

A physician has experimented with an instrument called an "Ergograph," as to the effects of sugar on a tired and useless muscle. He finds that a muscle which has lost its "irritability," regains its power of contraction within 10 minutes of the inception of a strongly-sugared liquid, recovering almost its full force about 35 minutes after.

This, then, is practical proof of the value of sugar as a food, and I can confidently recommend the use of good pure sweets (in moderation) by men in training.

Some years ago, a great idea for men while training was to consume large quantities of meat, and even now some men imagine that meat is the staple portion of an athlete's diet: They are evidently not aware that as much as 90 per cent. of meat is water.

How often have I heard men say—"Ah! there's nothing like a good pound of steak, or two or three chops, to keep up the strength!"

This is not the case; the digestive organs are only capable of a certain amount of work at a time. If given too much work, as, for example, eating a pound of steak at one meal, some portion of that work must necessarily be either neglected or ill-performed; the greater amount of food taken in such quantities will be passed from the system, carrying with it those nutrient qualities which were meant for absorption into the organism.

If, on the contrary, a small quantity of meat be eaten three times per day, never exceeding in the aggregate $\frac{3}{4}$ lb., the probability is that the whole of the useful properties of the meat have been assimilated

and distributed to those portions of the system as required.

I think sufficient has been said about food, and it must be left to the individual taste to decide exactly what shall be eaten and what not.

There are, of course, several luxuries in food which are of no practical value to the man in training and must consequently be put on one side.

Do not drink too much of any kind of fluid; try and cure that thirst, which, in the early stages of training, is almost unbearable, until one day you will be surprised how little fluid it is possible to manage with. About six ounces or half-a-pint is quite sufficient liquid to be taken at a meal. Although nearly five pints of liquid are necessary daily, a very large percentage is contained in ordinary foods.

One thing very liable to happen, after two or three months' training, is that a man may go "stale." The physiological reason for this condition is very simple and not far to seek. As explained in the chapter on "Physiology of Exercise," any movement, however slight, causes a waste of tissue; in the ordinary course of events, this waste will be eliminated, through one or all of the various channels provided for such waste. But it may happen, either from overwork or the sluggish action of the skin, that the waste material is not all thrown off. This waste material then becomes an irritant poison, which clogs the blood-vessels and absolutely prevents one from performing the usual work.

It is really a case of auto-poisoning, and the only way to get round is to rest for at least a week and take some opening medicine.

If training be persisted in when one has gone "stale," a state known as "consecutive fatigue" follows, when one is always tired and cannot sleep soundly. There are instances on record where some prominent athletes, cyclists, &c., have died from so-called typhoid fever, or, as Professor Peter calls it, *Auto-Typhisation*, simply through over-training or overwork. The subject of training is a peculiarly interesting one. It has in past years been much abused, and, instead of assisting in prolonging a healthy life, has in many cases had a diametrically opposite effect. If the keynote of moderation, however, be struck, training as set forth in this chapter can have no such effect, but will assist in the preservation of our young men's lives, chastity, manliness, and love and appreciation of sport.

There is yet another kind of training which may be undertaken by young and old of both sexes. It is not to fit them for any race (unless it be the ever present race of our 19th century high-pressure civilization), but simply as a means of obtaining health and strength. To be of use it must be constant, the morning bath must not be neglected, and meals must be regular and moderate. The exercise or training is simple, and if the exercises mentioned in the chapter on "Muscular Development" are regularly practised the results are certain. The only objection to exercises in which often repeated movements occur, is that they are somewhat monotonous. For this reason exercise with a friend if possible, in order to keep the mind contented, for experience has proved to me that exercising alone has not quite the effects intended.

Everyone does not wish to be very muscular or athletic, but surely every one desires good health; for, without health, life is scarcely worth the having, and the secret of health is not to be found in the quack advertisements of our daily papers, but in plenty of fresh air and sunshine, water and exercise.

Several of my friends whose occupations are of a sedentary nature, have by my advice snatched ten minutes during the day for either light gymnastics, or dumb-bell exercise. They all state they benefit greatly from this and although I cannot (owing to my occupation) appreciate the work to the same extent as they do, I fully believe that they really are better for even those few minutes given up to exercise.

Strength is a natural consequence of health; that is of course up to a certain point, for, naturally, abnormal strength requires special cultivation, but we must first gain health, which without exercise is almost impossible.

DIETARY TABLES.

Average Daily Diet of a Man weighing 154lb.

(According to Church.)

Food Constituents.	In 100 parts.	Each 24 hours.		
		lb.	oz.	grains.
Water, ...	81·5	5	8	320
Albuminoids, or flesh formers, .	3·9	0	4	110
Starch and Sugar, . . .	10·6	0	11	178
Fat, ...	3·0	0	3	337
Common Salt, ...	0·7	0	0	325
Phosphates, Potash, Salts, &c., .	0·3	0	0	170

The above amount will, under ordinary circumstances, maintain the body without either loss or gain.

It has been ascertained from various experiments that a mixed diet should contain twenty-two parts of nitrogenous matter, nine parts of fat, and sixty-nine parts of sugar and starch, by weight.

The following gives a simple and cheap diet, which contains a sufficiency of all the substances required by the healthy body :—

(According to PILLEY.)

Bread,	16 oz.	Altogether these articles will contain about 1lb. 6 oz. of dry substances though they weigh in the aggregate 6lb. 14½ oz., thus showing that 5½lb. are liquid, which would = about 5 pints.
Butter,	2 "	
Milk,	4 "	
Meat (Beef),	6 "	
Potatoes,	8 "	
Cabbage,	4 "	
Cheese,	3 "	
Sugar,	1½ "	
Salt,	½ "	
Water,*	66½ "	

*Alone, and in tea, coffee, and beer.

CHAPTER VII.

ELEMENTARY HYGIENE.

HYGIENE is the science which treats of the health of the body, and applies directly or indirectly to *everything* that goes to make up our present day civilisation—the houses we live in, the clothes we wear, and the food we eat.

It is, in fact, the science of the laws of health, and to be perfectly understood would require an acquaintance with Physics, Chemistry, Medicine, Engineering, Architecture, Bacteriology, &c.

To attempt, therefore, to include the whole subject of Hygiene in one chapter of a small work would naturally be impossible.

We need only consider purely personal Hygiene, which relates to such subjects as habits, food, cleanliness, bathing, clothing, and exercise.

Habits. — A habit may be either good or bad; that is, it may assist in promoting a healthy life, or it may be a predisposing cause of disease.

Eating.—In eating, one must be careful that the food is not eaten quickly, or swallowed before it is perfectly masticated.

Mastication, or chewing, is not solely for the purpose of cutting the food into small pieces as is often imagined. The food has to be mixed with saliva to admit of the proper chemical action taking place after it has been swallowed.

The habit of drinking with a full mouth is not merely vulgar, but is in direct opposition to the simple laws of mastication, which decree that food must be chewed and salivated before being swallowed and not merely "washed down." Eat slowly and carefully, therefore, for most quick eaters suffer sooner or later from indigestion.

Young people may eat more plentifully than their elders, because they require more of the chemical constituents of food to build up the growing body.

Drinking. — Do not drink in large quantities, or too frequently or quickly.

Water is the best liquid that can be taken, always providing that it is quite fresh and pure.

It is also the most natural drink that one can take, and is such a general solvent that by means of it, nutritive matter is carried to all parts of the digestive organs, and it is also necessary for assisting in the removal of waste matter.

An adult loses about eighty-five ounces of water in each twenty-four hours and requires, therefore, about four or five pints to make up this loss. It must be remembered, however, that all foods, even the driest, contain water in large quantities, and as much as a third of this amount will be contained in the food consumed during the day. This being the case, from three to four pints will be sufficient liquid for every twenty-four hours.

It is as well to know that some kinds of food contain a very large percentage of water—thus, cooked green vegetables contain ninety to ninety-five per cent.; lean meat, seventy to seventy-five per cent.; and bread contains thirty-five to forty per cent.

Alcohol.—The use of alcoholic liquors is a habit which often brings a whole host of evils in its train. It renders a man's capabilities for work less by weakening the heart's action; it also deadens the activity of the brain, and interferes with the oxidation of waste matters in the blood, thus altering the function and even character of the internal organs, most particularly the liver and kidneys. Athletes will notice most particularly the weakening after-effects of alcohol.

It is easily possible to do without any alcoholic liquor, though a moderate and restricted use may do no harm, and occasionally, as a medicine, do good by stimulating the appetite.

Tobacco.—Smoking is also a habit which need not be indulged unless the taste has grown so strong for tobacco that one can scarcely do without it; and then it should be indulged in moderately. For persons engaged in much mental (and not physical) work its use may be justified, as it certainly restores and soothes the fatigued nervous system.

Sleep.—Sleep, one of the most necessary habits we have, depends for its length on several circumstances, and is a very personal matter. As a general rule, those who earn their living mentally require less sleep than those who toil with their hands (or by muscular labour). It is only during sleep that

mind and body obtain *perfect* rest, and it is essential that it should be as far as possible regular and calm.

Children need more sleep than grown-up people, a young child requiring at least twelve hours in every twenty-four; an adult man, eight; women, seven; and young lads and girls, nine hours. The night is the natural and best time for sleep. Plenty of fresh air is necessary in bedrooms, but care must be taken that a cold current of air is not in a line with the head. The top of a window should always be open a few inches, unless the room be provided with proper ventilators fixed in the walls.

The head should not be covered with the bed-clothes. Try and cultivate the habit of sleeping with the mouth closed (this can be done if attention be given to the matter), and also try and sleep with the limbs straightened out. This latter remark applies especially to the young and growing and persons training for running or cycling, &c.

The Skin.—The care of the skin, that beautiful covering which is provided for the human frame, is always rather a fascinating subject (more especially perhaps to ladies). In this they are quite right, but too often their method of obtaining that beauty is wrong.

The condition of the skin depends principally on three causes—

1. The quantity and kind of food taken, and the manner in which it is eaten.

2. The general state of the internal organs, more especially perhaps those concerned in the work of digestion.

3. The proper cleansing and drying of the skin.

In health, the skin through its minute pores is always giving out the watery and fatty secretions before described, and the skin itself is always throwing off dead scales, all of which must be removed. (See chapter on "Physiology of Exercise.")

The dust and dirt which one encounters in the air are caught and remain on the skin, and if not removed eventually clog the pores.

Washing and Bathing.—Now, although bathing has been referred to in the chapter on "Training," a few more remarks can well be added.

A plentiful use of cold water is an excellent tonic to the skin, but to remove the waste, and for purposes of cleanliness, soap and friction are necessary. Thus, the whole of the body should be thoroughly cleansed with soap and water once each day. As to the temperature of the bath, what would be cold to one person would be very cold or even unbearable to another, for no two persons are equally sensitive to the effects of heat and cold.

A cold bath, however, may be about 45 degrees and up to 60 degrees, above which it would be called tepid. A very hot bath would be anything from 100 to 110 degrees.

Now, although a cold bath is needful for all healthy persons every morning, this is not sufficient to really cleanse the skin; a Turkish bath. to those who can get one, taken about once a month, and an ordinary hot bath every week, would be necessary to keep the skin perfectly clean.

It must be urged on all alike not to let any obstacle stand in the way of the *morning* bath for

the sake of cleanliness, health, and a beautiful skin; and remember a healthy skin means a great deal toward a healthy body.

Clothing.—The main objects of clothing are to protect the body from the variable climate to which it is subjected, and to maintain it at an equable temperature. The materials used in its manufacture are obtained from animals and vegetables. From the animal world we get wool, fur, feathers, silk, and leather; while from vegetables we obtain cotton, flax, coir, jute, hemp, indiarubber, and guttapercha.

The material of which clothes are made should be as light in weight as is consistent with sufficient protection from our variable climate.

Loose clothes are warmer than tight-fitting garments, and also admit of freer movement. One reason for this is because there exists between the body and the covering a thin layer of air, which is a bad heat conductor, and does not facilitate the passage of heat from the body.

Thus, although warmer in winter, loose clothing is also cooler in summer, for by the same reasoning we find that the heat will not penetrate the layer of air between the clothing and the body from the outside, any better than from the inside.

The materials used for clothing differ greatly in value, either as heat retainers or non-conductors.

Silk.—First and most valuable in every way comes silk. It is an almost ideal material for undercloth-ing, and though expensive will last much longer than other materials, such as wool or linen. It has all

the advantages of wool and in addition is light, smooth, soft, and does not irritate the skin.

Flannel.—Next in order comes flannel, made from wool. It is a bad conductor of heat, absorbs moisture readily while giving it off so slowly that the cooling process does not take place so rapidly as with linen, &c.; thus the liability to contract a chill after violent exercise has excited perspiration is not so great with woollen underclothing as with linen or cotton. The great disadvantage with flannel is that it hardens and shrinks with washing, unless with very careful treatment.

Linen.—Linen, made from flax, is the smoothest and coolest material used for underclothing, but cannot be compared for warmth and comfort with wool, silk, or cotton. Its disadvantage is that it cools so quickly and retains the perspiration, retarding to some extent the healthy action of the skin, unless very frequently changed.

The underclothing should be of a natural colour, as the colouring matter employed often contains injurious chemicals, which when placed next the skin and in contact with the perspiration frequently causes eruption of the skin. In the case of those who perspire freely and those engaged in muscular work, a change of underclothing twice a week is recommended. Underclothing worn during the day should be removed before going to bed.

The only remark it is necessary to make concerning the outer garments is, that they should be as light as is compatible with warmth and protection.

If one remembers the three following axioms as to our garments there can be but little mistake.

1. No article of clothing should fit so tightly as to in any way impede either the circulation or muscular action.

2. No garment should be any heavier or contain more material than is absolutely necessary.

3. All garments requiring suspension should be suspended from either shoulders or hips.

Exercise.—The chief condition of health is exercise in the open air, and those who have most of it are, almost without exception, the healthiest. The desire for muscular exercise is a natural instinct strongly implanted in all animals and equally in the human being. The restlessness of young children is a plain proof of this.

Muscular exercise is most important during the first twenty-five years of life while the frame is growing, and for two special reasons—Its influence (1) on the general health, and (2) on the brain.

Owing to the increased size and strength of the muscles consequent on exercise, they respond more easily and accurately to impulses of the will, the action of the lungs is increased, and more pure air is thus inhaled. The circulation of the blood is improved and the heart strengthened, the action of the skin increased, and thus an important means of elimination of impurities is assisted in its work.

School Life.—During the period of school life, the brain, like the muscles, is undergoing growth and development. They cannot be treated separately one from the other, being too intimately connected

by means of the nervous system. It follows, therefore, that both should be educated and trained co-equally, provided always that neither training be carried to excess or at the expense of the other.

Muscular exercise must not be pushed to such an extreme as to leave no time for the cultivation of the mind; neither should mental maturity be obtained at too early an age at the expense of stability and bodily power.

In schools, large play-grounds are usually provided, where during play-hours a purely natural and spontaneous activity is noticeable amongst the children.

Gymnastics.—This natural activity is really more conducive to general strength than any formal gymnastics. At the same time, gymnastics as a semi-compulsory form of exercise should form a part of the educational curriculum of all schools, being likely to give better all-round results than any games. Military and musical drill should also form part of a child's daily work at school. It serves to teach order and promptitude of obedience, and is a valuable means of exercise.

Girls.—Girls suffer from an insufficiency of exercise to a much greater extent than boys, though within the last few years the authorities that be are awakening to a sense of their responsibility in this matter. A half-hour per day (in the morning for preference) should be devoted to calisthenics and drill, which should be as interesting as possible; it should be made impossible to think of other school work during this period.

In taking muscular exercise the following rules should be always observed:—

The clothing should be loose to allow of free play of the limbs and expansion of the chest. Flannel or silk should be worn next the skin. The exercise, especially for the young, must be systematic and regular, and its amount regulated by *individual* fitness, care being taken that every part of the body receives some work. It should not be taken immediately after a meal; in fact, two hours is the usually accepted period of rest required. After completing the work, care must be taken to keep out of draughts and to cover the chest and throat.

Works on Drill.—There are several excellent works containing exercises suitable for boys and girls, chief among which may be mentioned—Ling's "System of Drill"; Blaikie's "Sound Bodies for our Boys and Girls"; and Chesterton's "Manual of Physical Drill."

So much has been said about *Exercise* that we must not forget that there is yet another side to this subject.

Rest.—Life is made up of action and rest. Exercise must be followed by rest, during which effete matters are removed by the blood and fresh nutritive material supplied by the same fluid. It may be partial or general; partial rest is obtained by a change of occupation which will bring other organs or other muscles into operation.

Sleep is the only form of general and complete rest, as during that time even the heart and lungs

perform their work with little more than half the labour required when awake. If a person can eat and sleep well, one can be sure that the brain at all events is not over-worked.

If the foregoing simple rules of life be followed, one may be almost certain of obtaining life's greatest blessing—health ; and more, an ability to resist the attacks of disease.

There is no better way of obtaining a healthful and happy existence than by making sure that our organism is in (practically) perfect working order, and no better way of keeping it so than by rising in the morning, taking some exercise with dumb-bells, followed by a cold bath and breakfast.

Exercise and cleanliness are perhaps the two greatest factors in a healthy life, and undoubtedly give an appreciation of existence unknown to the person lazy and careless in these matters.

CHAPTER VIII.

HINTS TO TEACHERS.

IN referring to teachers, I mean those who in addition to their other educational work are required to teach drill to their pupils.

In most of our cities the Board-schools have adopted some system of drill in order to obtain a higher money grant from the Government, and (except where professional Drill and Gymnastic Instructors are employed) this system is required to be taught by the teachers.

Where no actual system is laid down by the Board, teachers are free to devise and invent their own kinds of drill, or obtain their knowledge from one of the many books on the subject.

But no book can teach the *manner* of instruction; nothing but experience can give one the necessary skill and patience requisite for the instruction of young children in drill. True, one occasionally comes across cases of teachers who take up the instruction of drill as "to the manner born," and such might do worse than take an advanced course of lessons in drill and gymnastics.

Exercises in drill should be made as amusing, instructive, and variable as possible, consistent with their containing the necessary amount of physical value.

On forming up a class for drill, recollect that the time at disposal is limited—usually about half-an-hour being allowed. Yet although a half-hour is a very short time in which to teach any subject, one must remember that it is a long time to expect children to stand listening to explanations. It is advisable, therefore, that the children should "stand at ease" during explanations, and that the teacher should show them the position required before asking *them* to do the movement, for it is much easier to remember a movement personally illustrated than by all the verbal explanation in the world. It will also save the instructor much trouble and talk, for in every class will be found some inattentive ones, who, however, may be made to watch where they will not listen.

Remember, therefore, to always "set" or personally perform the exercise first.

Do not expect children to learn to go through an exercise or series of movements without pause, known as "judging the time," too early. If they be hurried on too fast the movements and positions especially will be very faulty, and bad habits are hard to eradicate. Be sure that every different position in a series of movements is correctly obtained, when working "by numbers."

When the class is commencing to work "judging the time" or to music, do not allow them to lapse into a lazy manner of working.

When an exercise admits of quick, sharp movements, see that those movements are made quickly, and the correct attitude shown before proceeding to the next position. Exercises which have bending or swaying movements should, as a rule, be performed slowly to admit of as much grace as possible in their execution.

Insist on the work being done with "life" in the various movements; put as much physical labour into the half-hour lesson as possible.

To the older children a little explanation of the physiological value of their movements may be given in a short and concise form; they will thus become interested, and gradually learn what a wonderful and complex piece of machinery they actually are.

Never punish a child for inability to perform any exercise. Many exercises require an amount of strength to perform, which some children do not possess, and this is one serious disadvantage of class work, that the exercises in mass drill must either be made to suit the weakest member, or else the weakly ones must be allowed to rest whilst the stronger continue the work.

After performing an arduous exercise, permit the class to "stand easy" for a few seconds to allow them to change their position. Vary the exercises as much as possible so as to sustain the interest, for children are always anxious to learn something which to them is new. The possibility of movements in the human frame is so infinite that there can be no difficulty in providing an apparently new exercise.

In mixed classes, the girls should be always placed on the *left* of the line, so that when opened out into spaces for drill they will be *behind* the boys. In teaching girls to drill, one must remember to be more gentle in speech than is necessary for boys, who are naturally rougher in manner, and would not notice some little speech or mannerism which a girl might consider in the light of a scolding. This may in a great measure be left to a sensible teacher's discretion, for there is scarcely any subject more absorbing and interesting to the teacher than the progress of a class in physical education.

There are several works which will assist teachers in providing a constant change of useful exercises for classes. Among them may be mentioned Chesterton's "Manual of Physical Drill," containing the exercises approved of and in use by the London School Board; and "Sound Bodies for our Boys and Girls," by Blaikie.

All teachers should make themselves proficient in drill, in case at any time they obtain an appointment where drill must be a part of their knowledge.

It is advisable where practicable to attend evening classes for this subject, and gain both practical and theoretical knowledge of the subject. In most large towns, teachers under the School Boards form classes for instruction in either gymnastics or drill, or both. These classes in some places are almost compulsory; but it is only fair to state that in the majority of cases the work is greatly appreciated.

Any teacher possessing the certificate of the British College of Physical Education is qualified

to teach drill efficiently, and will find no difficulty in obtaining any situation where "knowledge of drill will be considered a recommendation."

The following are a few of the now numerous kinds of drills which are recommended :—

For boys and girls — ordinary marching and Swedish movements, light dumb-bell exercises. Girls only (or very young children) — fan drill, hoop drill, tambourine drill, scarf drill, flag drill, braid drill, skirt drill, ring exercises, May-pole exercises, skipping-rope dances, &c.

APPENDIX No. I.

DUMB-BELLS.—Table of Weights to be used according to Age and Sex.

SEX.	AGE.	PERIOD.	WEIGHT.	REMARKS.
Boy or Girl....	7– 9	First 6 months.	¼lb each hand.	Small wooden bell, ½lb second 6 months.
" "	9–12	First year.	1lb "	Wood with iron core or ends.
Boy.....	12–14	"	3lb "	Small iron bell.
Girl.....	12–15	"	2lb "	" "
Boy.....	14–17	"	4lb "	" "
Girl.....	15–18	"	4lb "	No further increase in weight.
Youth.....	17–19	Throughout these 2 years.	7lb "	Gradually increase number of movements.
Youth.....	21 and upwards		8lb "	Increase 1lb every 6 months until maximum of 15lb is reached.

Boys and men will always require to perform a greater number of movements than girls or women, though care must be taken not to do too many movements in any one exercise, and if the exercises have been commenced only recently a little smaller bell should be at first used than above mentioned; for instance, a youth of 21, unused to exercise, should commence with not more than 3lb. dumb-bells.

APPENDIX No. II.

SPECIMEN TABLE FOR NOTING MEASUREMENTS.

	Commenced.		1st Mon.		2nd Mon.		3rd Mon.		4th Mon.		5th Mon.		6th Mon.		Total Increase.	
	Ins.	Sths.	Ins.	Sths.	Ins.	Sths.	Ins.	Sths.	Ins.	Sths.	Ins.	Sths.	Ins.	Sths.	Ins.	Sths.
Neck																
*Chest (Maximum).....																
*Chest (Normal).....																
Forearm																
*Upper Arm																
Waist																
*Thigh																
Calf																
Height.....	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.

* See instructions on Appendix III. as to manner of measurement.

APPENDIX No. III.

TABLE SHOWING THE INCREASE MADE BY THREE PERSONS (MALE) OF DIFFERENT TYPES IN A PERIOD OF SIX MONTHS BY A SYSTEMATIC COURSE OF DUMB-BELL AND FREE GYMNASTIC MOVEMENTS :—

	A, age 18.						B, age 25.						C, age 29.					
	Commenced.		Finished.		Increase.		Commenced.		Finished.		Increase.		Commenced.		Finished.		Increase.	
	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.
Neck.....	14	0	15	1	1	1	14	3	15	2	0	7	14	4	15	4	1	0
(1) Chest (max.)	32	5	38	0	5	3	35	1	37	0	1	7	38	1	40	7	2	6
(2) Chest (nor.)	31	1	36	0	*4	7	33	7	35	1	1	2	36	5	38	3	1	6
Forearm....	8	7	10	1	1	2	10	4	11	0	0	4	11	1	11	6	0	5
(3) Upper Arm	9	1	11	2	2	1	11	7	13	6	1	7	12	6	14	2	1	4
Waist.....	27	5	28	1	0	4	28	4	28	6	0	2	28	6	28	7	0	1
(4) Thigh.....	19	2	20	4	1	2	20	0	21	0	1	0	21	3	21	4	0	1
Calf.....	12	6	13	2	0	4	13	2	13	4	0	2	13	3	13	5	0	2
	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.
Height.....	5	$7\frac{1}{4}$	5	8	0	$\frac{3}{4}$	5	$6\frac{1}{2}$	5	$6\frac{3}{4}$	0	$\frac{1}{4}$	5	5	5	5	0	0

(1) Measured while lungs inflated to fullest capacity.
(2) Measured while standing naturally, tape under the shoulder-blades and over the nipples of the breast.
(3) Tape round thickest part of biceps, with arm flexed.
(4) Tape round thickest part of thigh, usually 4 or 5 inches below the "Great Trochanter."

* *This abnormal increase is mainly due to the development of the "latissimus dorsi" and "pectoral" muscles, and not solely to enlargement of chest.*

APPENDIX No. IV.

Approximate Table of Measurements of the Body in relation to Height.

They are normal and refer to Male persons who take a sufficiency of bodily exercise. Persons whose occupations are of a sedentary nature, and who do not indulge in sports or games, such as Gymnastics, Rowing, Foot-ball, Golf, &c., will probably find that their normal measurement is as much as 1 inch below the minimum standard given below, and their waist 1 or even 2 inches more. As advanced or more arduous exercise is undertaken the chest and arm measurements increase and the waist decreases until a set size is reached.

Height.		Chest.						Arms.				Waist.		Thigh.	
		Minimum.		Maximum.		Normal.		Forearm.		Upper Arm.					
Feet.	Inches.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.	Inches.	8ths.
5	0	29	0	33	0	30	7	10	0	11	3	27	0	20	3
5	1	29	7	33	7	31	6	10	1	11	4	27	1	20	4
5	2	30	6	34	6	32	5	10	2	11	5	27	5	20	5
5	3	31	5	35	5	33	3	10	3	11	6	28	0	20	6
5	4	32	4	36	4	34	0	10	4	12	0	28	2	20	7
5	5	33	3	37	3	34	5	10	5	12	1	28	5	21	0
5	6	34	2	38	2	35	3	10	6	12	3	28	7	21	1
5	7	35	1	39	1	36	0	10	7	12	4	29	2	21	2
5	8	36	0	40	0	36	7	11	0	12	6	29	7	21	3
5	9	36	7	40	7	38	0	11	1	12	7	30	3	21	4
5	10	37	6	41	5	38	4	11	2	13	0	30	6	21	5
5	11	38	5	42	2	39	0	11	3	13	1	31	1	21	6
6	0	39	4	43	0	39	5	11	4	13	3	32	0	21	7
6	1	40	3	43	6	40	1	11	5	13	4	32	1	22	0
6	2	41	2	44	0	40	7	11	7	13	6	33	0	22	2

The Thigh measurements will be found much larger amongst Cyclists and Gymnasts, especially the former, often as much as an inch more than that given here, for their height.

APPENDIX No. V.

Approximate Table of Weight for Height, for Heavy, Medium, and Slight Persons.

Height.		Heavy.		Medium.		Slight.	
Feet.	Inches.	Sts.	Lbs.	Sts.	Lbs.	Sts.	Lbs.
5	0	10	0	9	4	8	10
5	1	10	1	9	6	8	12
5	2	10	3	9	8	9	0
5	3	10	5	9	10	9	2
5	4	10	7	9	12	9	4
5	5	10	8	10	0	9	6
5	6	10	10	10	2	9	8
5	7	10	12	10	4	9	10
5	8	11	0	10	6	9	12
5	9	11	1	10	9	10	0
5	10	11	3	10	11	10	3
5	11	11	5	10	13	10	5
6	0	11	9	11	1	10	7
6	1	11	12	11	3	10	10
6	2	12	0	11	5	10	13
6	3	12	3	11	7	11	1
6	4	12	6	11	10	11	4

Remarks.—These weights refer to those who are in really good condition; though of course it is quite possible to be as much as 6lbs. either under or over the weight given here without being in any degree "fat" or "thin." These weights are average and normal, and are usual in most healthy persons (male) between ages 21 and 31.

APPENDIX No. VI.

A List of Authors and Works from whom Quotations have been taken, or to whom reference has been made in this Book:—

"Anatomy,"	Quain.
"Physiology,"	Huxley.
"Chemical Physiology,"	Morris.
"Lectures on Physiology,"	Anderson.
"Evolution of Sex,"	Geddes and Thomson.
"Physiology of Bodily Exercise,"	Lagrange.
"Muscles and Nerves,"	Rosenthal.
"Mind and Body,"	Bain.
"Foods,"	Smith.
"Hygiene,"	Pilley.
"What is Life?"	Hovenden.
"Strength,"	Sandow.
"Method of Physical Training,"	Checkley.
"Science and Art of Training,"	Henry Hoole.
"Physical Education,"	Chesterton.
"Training,"	Zimmerman.
"Gymnastic Exercises,"	Maclaren.
"Scheme of Physical Culture."	Seymour.
"Home Gymnastics,"	Hoffmann.
"Gymnastics,"	Jenkin.
"Cycling and Health,"	Jennings.

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ERRATUM.

Plate I., No. 10.—*For* 'Obliquus' *read* 'Obliquus.'

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THE Topographical Anatomy of the Child

BY

JOHNSON SYMINGTON, M.D.,

F.R.S.E., F.R.C.S.E.,

Professor of Anatomy, Queen's College, Belfast; formerly Lecturer on Anatomy, School of Medicine, and Examiner in Anatomy, University of Edinburgh.

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The present work is founded upon the examination of a series of frozen sections of the bodies of children. It is illustrated by fourteen life-sized coloured Plates, and by a number of Woodcuts. Of the excellence and fidelity of the Plates it is impossible to speak too highly. They reflect the greatest credit upon the publishers.

The vertical medial sections and some coronal sections of the thorax are the most valuable. Sections are given of all parts of the trunk; of the skull, to show the orbits and nasal fossæ; of the neck, to show the position of the larynx; of the thorax, abdomen, and pelvis.

The First Part of the work is devoted to a critical explanation of the Plates. The Second Part deals systematically with the more conspicuous results of the author's investigations. The topographical anatomy of the auditory meatus and tympanum, the condition of the spinal curve in children, the topography of the brain, and the relational anatomy of the male and female genital organs, are all dealt with in an able and original manner.

Dr Symington's book abounds in original material. It is a work that no anatomist can afford to overlook. It adds materially to our knowledge of the most practical branch of anatomy, and is a credit to modern scientific research. —*The International Journal of the Medical Sciences*, October 1887.

While the anatomy of the human subject, during the earlier months of intra-uterine life, has been investigated with great care and minuteness, and while our knowledge of the topographical anatomy of the adult has been enriched by the labours of numerous investigators, comparatively little attention has been paid to the peculiarities in the anatomy of the infant, and the changes that occur from the time of birth up to that of adult life."—In these words Dr Symington gives the reasons that have moved him to undertake and carry through the investigation of which this volume forms the very tangible result. Not only is it true that very little has been published on the subject, but it is also true that no inconsiderable part of that little was erroneous; and there is scarcely a page of this book but corrects some common error, or throws new light on anatomical relations as they occur in the child.

The mode of investigation pursued has been mainly that by sagittal, horizontal, and coronal frozen sections of the body made at different levels, but supplemented by other methods where fuller information was required. The work is divided into two Sections, the First forming a running commentary on the Plates, and the Second a formal discussion of the points wherein differences are observable between the anatomy of the adult and that of the child.

Hitherto, anatomists have had no very clear ideas as to the date of formation of the air cavities in the mastoid, frontal, and superior maxillary bones, in all of which, but more especially the first, accurate knowledge as to their presence or absence at a given age might be of essential importance in a surgical aspect. Dr Symington has brought much evidence to bear on the subject, and if he has not settled the question, has done much to elucidate it. He found that the *antrum mastoideum* (a cavity, as he remarks, generally overlooked by anatomists) was present at the time of birth in all the specimens examined by him; but he is of opinion that the pneumatic cavities generally are not formed in the lower part of the mastoid till about the time of puberty. This it will be seen is an important observation in connection with the question of trephining the mastoid for suppuration of the middle ear. The frontal sinuses he found in his specimens to be absent at six years of age and present at nine, so that we have thus pretty clearly indicated the date at which they commence to form. In regard to the antrum of Highmore, he notes that, as a rule, it opens into the infundibulum, and not, as is commonly stated, into the middle meatus, although sometimes a second opening is found leading directly into the latter.

On the much disputed point as to the position of the heart in children, he dissents from the view that in them the base of the heart is higher than in adults. He calls attention, however, to the greater relative size of the heart, and the narrowness of the front of the chest in children, and remarks that as a consequence the apex of the heart reaches to, or even beyond, the nipple line, and may be felt in the fourth intercostal space as well as the fifth.

We would note as especially worthy of careful perusal, the section on the position and growth of the larynx, that on the production of the lumber curve of the vertebral column, and the elaborate account of Dr Symington's researches into the development of the jaws and teeth.

The numerous references at the bottom of each page testify to the painstaking care with which the author has studied the subject, as well as displaying a praiseworthy anxiety to give full credit to all fellow-workers in the same field.

We must not omit to express our high appreciation of the clearness, accuracy, and artistic finish of the coloured Plates. The numerous reference lines crossing their surface do to some extent mar their beauty, but these lines greatly simplify the understanding of the plates, and render unnecessary the usual reference tables, and to obtain so desirable a result even greater sacrifices might have been excused. We congratulate Dr Symington on the successful termination of his important investigation.—*The Glasgow Medical Journal*, November 1887.

To the study of sections of the frozen human body we owe most of the recent great advances in our knowledge of Topographical Anatomy. The older method of dissection causes a certain amount of displacement, and often destroys the relations of important deep parts to their superficial landmarks; and, therefore, until this new method enabled us to check the results of dissection, many false views were current concerning the actual situation of organs. Dr Symington's work is one of the most valuable contributions to the literature of Sectional Anatomy; and is one of the most creditable pieces of original research in this department that have been produced in Britain within the last few years. He has illustrated the topography of a number of parts which are of the deepest interest to the practical surgeon and physician as well as to the anatomist, such as the relative positions of the heart, lungs, and liver at different levels, the relations of the larynx and trachea, and the pelvic viscera in children of the two sexes. All of these are points concerning which the practitioner requires to have the most precise knowledge, on account of their bearing on tracheotomy, lithotomy, &c.

The letterpress has been written with much care, and shows an extensive acquaintance with the literature of the subject. We note with special interest the sections on the Topography of the Ear, the Jaws and Teeth, the Heart, and the Bladder, as worthy of particular attention. Altogether we can commend the work as an excellent and trustworthy guide, and one which the practical physician and the operating surgeon will do well to consult.—*The Practitioner*, August 1887.

The book before us is probably one of the most important contributions to our knowledge of human Anatomy that the Edinburgh School has furnished for many years, and Dr Symington may be congratulated on the completion of a work of such sterling worth. The task which the author set before him was the investigation of those peculiarities of structure which are to be seen between the time of birth and the attainment of maturity. These two extremes of the period have been often fully discussed, but not so the intermediate stages; hence the importance of trying to trace the steps of change from one to the other. Although it might have been possible to infer the association of peculiarities of structure from some that are well known, the method would have been a dangerous one, and unscientific; and Dr Symington has carefully and methodically followed the safer plan of original investigation. Since the differences to be expected are chiefly questions of the relative size and position of various parts and organs, no method of research was likely to yield such good results as that of frozen sections—the one adopted in the present instance.

The work is divided into two Parts. The First Part consists of a series of Plates, illustrating sections of the bodies of children cut in various directions, with sufficient explanatory text to make clear all peculiarities of structure, and with the addition of Woodcuts where considered advisable. The general plan of the sections is much the same as that carried out by Braune and other investigators of adult structure. The first Plate represents a mesial section of a girl, æt. 13; the next, a similar one of a boy, æt. 6. The third and fourth Plates represent various sections of the head; while from Plates V. to X. inclusive, serial cross sections of the trunk are represented. Plate XI. has one cross section, and one in the mesial plane illustrating the lower part of the abdomen and pelvis. Plate XII. consists of two most valuable figures, illustrating the relation of internal viscera to the abdominal and thoracic walls constructed synthetically from cross

sections. One is from the body of the girl, æt. 6, from which the series of cross sections has been figured; and the other is from the body of a boy, æt. 5, which was used to illustrate several doubtful points, and from which several woodcuts were drawn. Both views are from the front, and, of course, represent the thorax in extreme expiration. An extra view from behind might have been an advantage. On the figure of the female child's body are marked delicate lines, indicating the sections and a reference to the Plate where the view of the section itself may be found. This will prove of great service in the study of the Plates. Corresponding references to the woodcuts in the other built-up figure serve a similar purpose. Plates XIII. and XIV. are from vertical transverse sections of the thorax and abdomen. The execution of the Plates is excellent, and gives evidence of care no less than of artistic skill.

In the explanatory text Dr Symington has entered as much into detail as each Part seems to require. It would have been better had he mentioned the thickness of each section, so as to enable the reader to follow the series more easily, but the need for this is less since the synthetical figure has been given on Plate XII.

The Second Part is perhaps the more valuable portion of the work. Here, under separate sections, the peculiarities of structure of the child are systematically discussed. After an introductory sketch of the literature of the subject, the author takes up the Brain, and points out the important differences in its topographical relations to the skull in children and adults. The Ear is next discussed, and many facts either hitherto unknown or almost forgotten are brought under our notice. The Frontal Sinuses having been briefly referred to, a most interesting Essay follows on the Mode of Eruption of the Permanent Teeth, which will repay careful study. In like manner are treated the Vertebral Column and its Curves, the Spinal Cord, the Neck, Thorax, Abdomen, Male Pelvic Viscera, and Female Genitals. In all of these there is evidence of the same honest and careful investigation; while references to the work of others show that this department of inquiry has not been neglected. Some of the Sections have already appeared as original papers, but they are not less welcome when combined with much that seems quite new in a connected form.

"The Topographical Anatomy of the Child" will undoubtedly remain a standard work on the subject; and, while adding very distinctly to Dr Symington's reputation as an anatomist, will reflect credit on the School to which he belongs.—*The Edinburgh Medical Journal*, August 1887.

In der Bearbeitung der theoretischen Grundlagen liegt die Zukunft der Kinderheilkunde. Nur wenn durch immer neue Forschungen die Besonderheiten des wachsenden Menschen erforscht werden, muss die Berechtigung der Pädiatrie als Fachwissenschaft allseitig anerkannt werden. Natürlich darf solches Studium nicht allein dem Theoretiker überlassen bleiben. Auf dem Gebiete der Physiologie des Kindesalters haben auch thatsächlich die Kinderärzte wacker mitgeholfen, weit weniger auf dem der Anatomie (z. B. Fleischmann). Aber auch die Anatomen haben dieses Feld selten betreten, und als Henke für die erste Auflage des Gerhardt'schen Handbuches die Anatomie schreiben sollte, konnte er sich nicht auf eine Zusammenfassung des bisher Bekannten beschränken, sondern musste an allen Punkten neue Untersuchungen anstellen, die für die zweite Auflage bedeutend erweitert wurden, aber noch immer kein vollständiges Bild liefern. Seither hat Dwight (Frozen Sections of a Child, New York, 1881) fünfzehn aufeinanderfolgende Horizontalschnitte durch ein 3 jähriges Mädchen abgebildet und erläutert, die uns über einige Verhältnisse aufklären. Dieses Buch wird durch das vorliegende, dessen Erscheinen wir mit besonderer Freude begrüssen, bei weitem übertroffen. S., Lecturer der Anatomie in Edinburgh, hat bereits durch einige anatomische Arbeiten (The External Auditory Meatus in the Child, Journal of Anatomy and Physiology, 1885; Position of the Empty and Distended Bladder in the Male Child, Das. 1885; On the Relations of the Larynx and Trachea to the Vertebral Column in the Fœtus and Child, Das. Vol. IX. u. a. m.) den Dank der Kinderärzte verdient, im vorliegenden, W. Braune in Leipzig gewidmeten, prachtvollen Werke vereinigt er eigene und fremde Studien auf diesem Gebiete zu einem Ganzen

Auf die wichtigen Ergebnisse können wir leider nicht im Einzelnen eingehen, empfehlen dagegen allen Fachleuten das Buch aufs wärmste und hoffen, dass es auch ausserhalb des Gebietes der englischen Zunge zahlreiche Käufer finden werde. Der erste Theil enthält in grossen farbigen Tafeln: Sagittalschnitt durch ein 13 jähriges Mädchen, den gleichen durch einen 6 jährigen Knaben, drei Frontalschnitte durch den Kopf eines 5 jährigen Mädchen, einen Horizontalschnitte durch den Kopf eines 4½ jährigen Knaben, 13 Horizontalschnitte durch den Rumpf eines 5 jährigen Mädchens, Sagittalschnitt durch den Unterleib desselben Kindes, zwei schematische Bilder über die Lage der Brust—und Baucheingeweide bei einem 6 jährigen Mädchen und einem 5 jährigen Knaben, zwei Frontalschnitte durch einem 4½ jährigen Knaben. Einzelheiten sind in besonderen Holzschnitten erklärt. Jede Tafel wird von einer Erläuterung begleitet, welche auf die Unterschiede gegenüber dem Erwachsenen eingeht.

Der zweitt Theil Enthält die Literatur der anatomischen Abbildungen des Kindes und geht dann systematisch auf die Anatomie desselben ein. Es werden nacheinander besprochen: Gehirn, Ohr, Stirnbeinhöhlen, Kiefer und Zähne, Wirbelsäule, Hals Brustkorb, Unterleib, männliche und weibliche Beckenorgane. Auch hier helfen sehr deutliche schematische Zeichnungen zum Verständniss der Worte. Auch auf praktische Fragen (Tracheotomie, Steinschnitt) wird Rücksicht genommen. Der einzige Fehler dieses Werkes scheint uns die geringe Berücksichtigung des ersten Lebensjahres zu sein. Im Uebrigen können wir nur den Wunsch wiederholen, das Buch möge unter den Kinderärzten die verdiente Verbreitung finden.—Für die Ausstattung verdient die Verlagsbuchhandlung ein besonderes Lob, und es läge vielleicht in ihrem Interesse, wenn sie die Tafeln auch mit deutscher Erklärung erscheinen lassen würde, umsomehr als die englische Auflage, wie wir erfahren, eine sehr niedrige ist.—Raudnitz (Prag).—*Centralblatt für Kinderheilkunde*, 3rd September 1887.

Dr Johnson Symington has well filled a gap in our Topographical Anatomy. This department of anatomical science has been worked at most extensively and ably by Pirogoff, Braune, Luschka, and others, in the adult; but the method of frozen sections has hitherto been systematically applied to the child, in one case only, by Professor Dwight. Dr Symington has added to our knowledge by presenting us in this work with fourteen coloured lithographic illustrations, all life-size, and thirty-three woodcuts taken from sections of male and female children, aged four years and a half, five years, six years, and thirteen years, and has given us a large number of very accurate observations on the position of the various organs and viscera, and the changes which they undergo in the earlier periods of life. The horizontal sections have been taken from a girl six years of age, whilst the vertical sections (both coronal and sagittal) are from children of both sexes and various ages. In addition to the illustrations, the work is most valuable for excellent letterpress, treating very fully and minutely of the position of structures at all periods of early life, and it is evident that many of the views generally held in regard thereto will have to undergo considerable alteration. For example, Dr Symington shows that the external auditory meatus is relatively as long in the child as in the adult, when examined in the fresh state in subjects with the entire head frozen; that the spinal cord in the newly-born child ceases at much the same point as in the adult; that the child's neck is not relatively short, but that it is higher in relation to the vertebral column than in the adult. The common assumption that the position of the stomach in the child is vertical is also shown to be erroneous, and is proved by figures taken from an infant four days old, and from a girl six years of age. The portion of the book devoted to the position of the pelvic viscera in male children is of great importance to surgeons, and will be carefully studied in view of operations on the urinary organs in early life. Too much praise cannot be bestowed upon the author for the obvious care and industry with which he has pursued his investigation, and the accuracy and fidelity with which he has reproduced its results. Its dedication to Professor Braune is a most graceful compliment to an anatomist who has done more to advance the knowledge of Topographical Anatomy than any other worker in this special branch.—*The Lancet*, 22nd October 1887.

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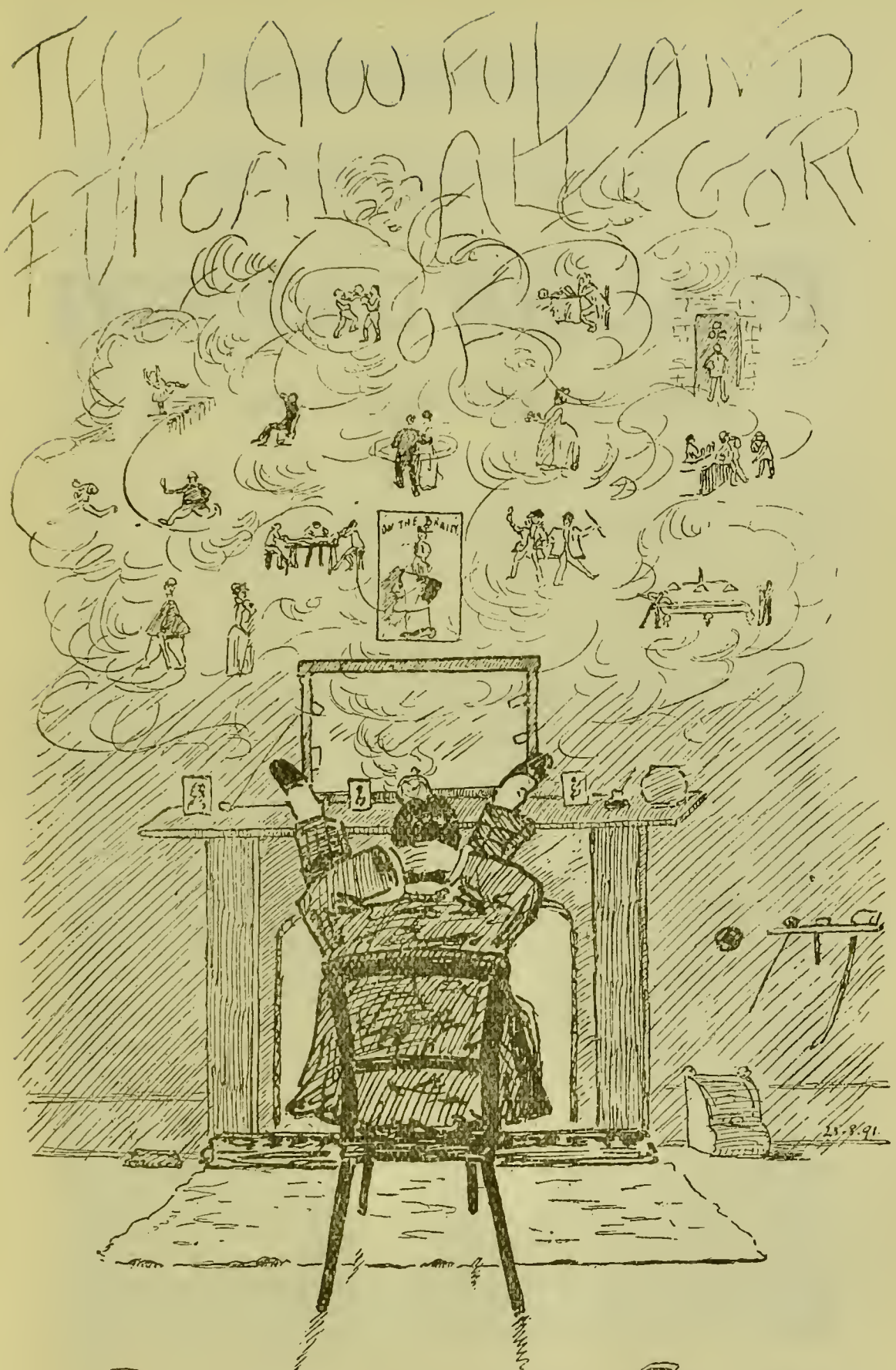
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SKIPPING FOR HEALTH.



A PLEA

FOR THE MORE GENERAL PRACTICE OF

SKIPPING

BY ADULTS AS WELL AS BY CHILDREN,

AS AN EXCELLENT FORM OF

Home Gymnastics

By FRANCIS T. BOND, M.D., B.A.Lond., F.R.S.Ed.,

Medical Officer of Health, Gloucestershire Combined District,

Honorary Secretary of the Jenner Society.

"SOLVITUR SALIENDO."

Variant from the Latin

PUBLISHED BY

THE SANITARY AND ŒCONOMIC ASSOCIATION LD.,

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PREFACE TO SECOND EDITION.

The demand for this little brochure has been so unexpectedly large, thanks to the favourable notice taken of it by the Press, that it has been necessary to reprint it at once without any appreciable alterations. But in so doing I think it well to make a small protest.

Skipping has, of course, a humorous as well as a serious aspect—as everything else has, and I was quite prepared for the amusing banter with which Mr. *Punch* and some of the writers of smart paragraphs in Society and other papers have received my modest suggestion that when in doubt what to do with their spare moments they should "try skipping." But when, as some of these *raconteurs* seem to indicate, I am represented as advocating skipping as a universal remedy, I feel it necessary to protest against being fathered with any such quackery. Skipping has, I believe, strong claims to consideration as a useful exercise on the grounds which I have ventured briefly to set forth. If I had had any doubt on the subject when I decided to place them before the public they would have been effectually dissipated by the communications I have received from persons who have used it with advantage. That it is so largely used by athletes in training as it appears to be I was not, I must confess, aware. And if my effort to give it a somewhat wider popularity without arrogating for it any absurd and unreasonable claims as a cure-all should be successful I shall feel amply justified for having made it.

F.T.B.



I HAVE no intention of discussing in this brochure the general subject of physical education, which has become almost a burning question of late; still less of describing or estimating the relative values of the various methods of bodily training which have been recommended for the development of our physical energies or the appliances which have been designed to give effect to them. Those who are interested in this subject will find abundant information on these matters in the numerous treatise on Gymnastics which have appeared in our own and other languages, amongst the most recent of which is the well-written and copiously illustrated serial which Messrs. Cassell and Co. Ltd. are issuing under the title of "Physical Educator" and the highly competent editorship of Mr. Eustace Miles, M.A. Nor do I propose to discourse at all on the antiquarian aspects of Skipping. I have little doubt that if Professor Flinders Petrie has not already exhumed evidence of the high antiquity of the practice some other explorer into the archives of antiquity will ere long do so. And it may possibly be found that one of the earliest uses to which our neolithic ancestors put the first strips which they succeeded in cutting with their "improved" knives from the pelt of some archaic beast was to fashion it into a skipping-rope.

My object here is merely to call attention to an exercise with which all my readers have doubtless been familiar in their childhood, which is, I believe, still popular with children, though not, I fancy, quite to the extent that it used to be in my own early days, but which,

as an exercise for any other stage of life, has been as completely neglected as if it had never existed.* And the best proof I can give of the truth of this statement is the fact that in the first number of the serial just referred to, although the principal appliances and methods suitable for Home Gymnastics are carefully described and a special course is prescribed for their use at home by "busy men," there is not one syllable about the practice of Skipping.

And yet I venture to say that there is no other form of exercise which combines in itself so many advantages for Home Gymnastics as Skipping does. Let us see what they are.

The Criteria of Comparison.

But before doing so it will be well to examine briefly the conditions which any form of exercise should fulfil to qualify it for a high position as a means of physical training.

1. It should be capable of bringing the largest number of muscles possible into action, and thereby of stimulating the circulation of the blood in all parts of the body. For it is obvious that if we want to develop the muscular system, which is the primary object of physical training, the more muscles we can bring into play the better.

2. It should also be capable of being graduated easily in regard to the energy with which it is used.

*It is true that in the training of athletes and pugilists skipping has always held a high place. But, so far as the general public are concerned, it has, for adults, been a lost art.

For it is of the essence of all systems of training, whether mental or physical, that first efforts should be small and not pushed to exhaustion, but that they should be gradually intensified until the highest possible results, consistent with well-being in other respects, have been attained. In the old fable, the boy was put to carry the calf that, as both grew into adult life, he might end by carrying the cow.

3. This graduation of effort should be capable of being effected with as much precision as possible, that we may be able to measure the increase of work which we impose upon the body, and to regulate it intelligently. All forms of physical exercise, like all forms of mechanical work, are reducible to expression in a definite unit, the foot-pound, *i.e.*, one pound weight lifted one foot high. And, though it may not be practicable for every person who embarks on a course of gymnastics to estimate in foot-pounds the relative amounts of energy he expends in the movements he makes, it is at least desirable that he should be so far able to appreciate each increment of work he imposes on himself, that he may form an approximate quantitative estimate of the gain he has realised during the course.

In this respect, walking, as a systematic exercise, has a high value. For, suppose a man to start his course of walking exercise, by covering, say one measured mile the first day, two on the second, and so on, for as long as he is capable of keeping up that rate of increase, he knows that, say on the tenth day, when he has walked ten miles, he has expended just ten times as much energy as he did on the first day.

Any form of exercise which can be thus quantitatively valued with an approach to precision has a manifest advantage for purposes of training over those which cannot be so.

4. Lastly, it is clearly a recommendation of any form of exercise that it is easily and cheaply available, that it can be practised anywhere, that it can be taken up at any odd intervals of leisure, and that it can be acquired with ease by anyone who will make the small amount of effort necessary to do so.

Skipping compared with other forms of exercise.

Having seen what are the conditions which any form of exercise should fulfil to entitle it to claim efficiency as a means of physical training, we shall be better able to appreciate those of Skipping.

And first, as to the extent to which it promotes general muscular activity.

It is obvious that skipping calls chiefly into action the lower limbs, and more especially the muscles of the thighs. The action of the skipper is in some respects that of one who mounts a staircase. One foot is raised by quickly flexing the corresponding thigh, and then the other foot is raised in a vertical line with a jump. At this moment the skipper whirls the rope under his uplifted feet, which then drop to the ground, to be again elevated by another spring upwards, and so on until the movement is voluntarily arrested, or is stopped by the entanglement of the rope with the feet through fatigue.

The form of exercise with which Skipping thus far most compares is cycling. But it is superior to cycling

in providing a certain amount of work for the arms as well as the legs. In both respects it also resembles walking, than which, however, it is somewhat more energetic.

Skipping as a graduated exercise.

In its easiest form Skipping does not call for much effort if the skipping appliance is so constructed as to enable it to be kept in rotation slowly and with slight effort. But it may be intensified in a high degree by increasing the rate of rotation of the rope; and in the modification known as "doubling" and "trebling" the muscular effort required is great, and fatigue soon comes on. Indeed, even the most restrained form of the exercise will be found rather hard work at first by those who are not accustomed to it.

And it is the great advantage of Skipping that it can be so easily graduated to the physical capacities of those who indulge in it.

For it is essentially a rythmical exercise. Each revolution of the rope at a given rate represents a definite expenditure of energy. And so uniform is the exertion that the ratio of energy expended in any number of skips is exactly represented by the number itself, the amount of work with each individual being almost invariable.

We can thus measure with great precision the amount of exercise taken; it can be exactly distributed over any given period of time; and it can be increased or diminished with as exact a knowledge of what we are doing as is the case with walking.

It is this capacity of graduating it which so strongly recommends Skipping as a means especially of strengthening the heart.

One of the most valuable effects of all systematic exercise is to stimulate and strengthen the heart, the most important muscle in the whole body. But to do this, especially in adult life, when the heart is often beginning to be enfeebled by depressing influences of various kinds, requires much caution. The effort imposed on the heart must be very small at first, and its effect should be carefully watched.

To this form of discipline no exercise lends itself so effectively as does Skipping. One, two, five, or more skips may be taken to begin with. The number may be repeated after any given interval of time, and it may thus be cautiously increased, the response of the heart to the stimulus of the blood driven into it by the effort noted and the exercise regulated accordingly.

Another feature of skipping is that it is a jolting movement. Now one of the recommendations of horse exercise is the effect which the jolting of a good trot has on the action of the abdominal viscera and especially of the liver. To what extent the jolting of skipping operates in this way it is difficult to say; but that it does shake up the skipper pretty actively anyone who practises it will soon satisfy himself.

Lastly, it is no small recommendation of Skipping that it can be practised either in the house or in the open air. Almost any room or passage can be used for the purpose, including one's bedroom.

There may be an objection in this latter case from the vibration produced if the floor is at all shaky. But even this may be much lessened by acquired skill in skipping lightly. The novice in the art of skipping will always be clumsy as novices are in all other arts; but after a time he will acquire the power of stepping so lightly that his action will be almost noiseless and with scarcely any jar. For this reason skipping in rooms with boarded floors is generally best practised with only light and tight shoes or in socks or with bare feet.

Where there is no difficulty about skipping in the bedroom the exercise may be indulged in with advantage before retiring to bed, especially where occupation during the day is of a sedentary character.

A short skip will predispose to sleep by creating a slight feeling of fatigue and by stimulating the circulation of the blood in the extremities.

Those who suffer from sleeplessness will find few better ways of wooing slumber than by getting out of bed, throwing the bed clothes well back, and then having a good skip.

In the morning, also, a short bout will clear off the stiffness of the limbs which is often experienced on getting out of bed, and will send the blood coursing through the lungs, thus helping to eliminate the mucus which tends during the night to accumulate in the bronchial passages.

When combined with the imbibition of a tumbler of cold water the healthy activity of the bowels will also be promoted.

After sitting and writing for some time, when the hand gets cramped, the feet cold, and the brain fatigued, there is no better reviver than to have a good skip.

Skipping as a Home Gymnastic.

From what has been already said it will appear that Skipping has a high claim to consideration as a form of Home Gymnastic.

In this respect, the only exercises that compete with it are the use of Dumb Bells, of Clubs, and of the Elastic Expander.

All these latter appliances, however, are adapted to develop only the muscles of the upper limbs and chest. Excellent as they are in their way, they are not rivals to Skipping; they only complement it. But, whilst they provide no play for the lower limbs, Skipping, though primarily the gymnastic of these limbs, also, as we have seen, finds occupation for the upper ones. The Japanese, who have made a scientific study of gymnastics for centuries, have appreciated in a much higher degree than we have done the importance of special exercises for the development of the lower limbs. In Mr. Hancock's recently published work on Japanese Physical Training, he devotes a whole chapter to the description of "exercises that develop the legs," observing that "while the development of the portion of the body from the waist to the shoulders, and including, of course, the rigorous training of the arms, is considered by the Japanese trainers as being of prime importance, only a few days are passed in the *jiu-jitsu* scheme before the student is taught how to strengthen his legs." The great object of the *jiu-jitsu* is the acquirement of agility, and this

largely by a process of combat between rival gymnasts.

Skipping, then, is not a *game* like Lawn Tennis or Golf or numerous others that might be mentioned, which are admirable means of promoting the general health by the muscular exercise and nervous excitement which they call forth. Nor is it an out-door exercise like Cycling, or Riding, or Rowing, which can be indulged in only by those who have means and leisure for so doing. But it is an unequalled resource for those who wish, at no appreciable expense and with little expenditure of time, except at odd moments that are at the command of everyone, to supply the lack of out-door exercise, which their occupation during working hours imposes, by exercise of a kind that is calculated to do for them all that any kind of home gymnastic can offer. Skipping is cheap, easily acquired and effective.

Skipping in the treatment of some forms of disease.

Although the main object of this brochure is to interest the general reader in an exercise which, as has been explained, has high claims to employment as a means of maintaining the health and developing physical vigour, it may not be out of place to say a few words on the use of skipping as an aid in dealing with some forms of disease.

Pulmonary Disease.—It is now well recognised that the foundation for probably all forms of lung mischief is laid by imperfect expansion and aeration of the lungs, and consequent enfeeblement of their power of resisting the attack of specific infections which find their way into the pulmonary tissues either through the blood or by inhaled air.

Full and frequent inflation of the lungs, such as is promoted by active muscular exercise, is the best way of strengthening their resisting power to disease. The experience of Consumption Sanatoria shows also that it is to the same practice that we must look for the most effective means of enabling the constitution to throw off the insidious hold which tuberculosis establishes on the lungs, at any rate in its earlier stages.

The indication, therefore, seems clear that an exercise which stimulates the action of the lungs so effectually as skipping does, offers great advantages, when judiciously used and under medical supervision, for employment as an element of the general hygienic treatment upon which most reliance is to be placed in dealing with this disease.

In Bronchitis also, especially of a chronic kind, the same indication is evident. Bronchitis is an affection which is largely due in its incipience to imperfect aeration of the lungs, establishing in them a diminished resistance to toxins which find their way to these organs through the blood, and possibly also to specific germs which are carried into them by the inhaled air.

In the treatment of this affection the systematic expansion of the lungs is of the first importance. It will not by itself effect a cure; but, when combined with judicious treatment in other respects, it will be found a potent adjuvant in effecting a cure and in strengthening resistance against future attack.

Heart Disease.—Heart failure has of recent years come to be recognised as an increasing source of bodily disablement and death. Its causes are various, and none but a trained physician is capable of dealing

properly with an affection of such a variable nature. But it may be safely said that in certain phases of this affection, and especially in its earlier stages and in the absence of serious organic lesion, physical exercise, judiciously undertaken and properly regulated, under medical supervision, and in combination with appropriate dietetic and remedial measures, is capable of producing marked benefit. For such a purpose skipping offers the advantage before alluded to, that it can be regulated with as much precision as uphill walking, the form of exercise which has been employed with most advantage in those cases of heart failure which lend themselves most readily to treatment.

Nervous Disease. — In those forms of nervous affection, especially of children and young persons, such as chorea (St. Vitus' Dance) and fits of a hysteric or epileptoid character, unaccompanied by any evidence of localised organic mischief, in which the malady appears to consist in involuntary nervous discharges, of either a continuous or spasmodic character, the use of muscular exercises of a rythmical nature is often very beneficial. It is now a good many years since I first published my own experiences of the value of Skipping in the treatment of St. Vitus' Dance, and suggested its employment in other allied forms of nervous affection.

The philosophy of the treatment is extremely simple : it substitutes a continuous and rythmical for irregular and explosive nervous discharges, and in so doing tends to strengthen the power of voluntary control over an excitable nervous system, the enfeeblement of which lies at the bottom of all this class of neuroses.

THE GIRBOLA.

The extent to which Skipping can be popularised as an exercise for adults must depend very much on the facility with which it can be practised.

The common Skipping Rope, in the form in which it has been used by children, from time immemorial, though a simple is a defective appliance, not well adapted for use by "grown ups," especially by those whose joints are somewhat stiff and to whom Skipping is a lost art. It is too light for easily regulated motion, and from this cause, as well as from want of smooth rotation at the handles, it is apt to get twisted at the distal end, and thus to catch the foot and so stop the movement. This causes unnecessary fatigue and annoyance.

To obviate these defects the **Girbola*** has been designed. The cord used, which is specially prepared for the purpose, is sufficiently thick and heavy, and at the same time sufficiently flexible to give it the weight necessary for steady and rythmical movement without involving unnecessary effort. The distal end is covered by a rubber sheath, which without interfering with its flexibility distends it in such a way as to facilitate its passing under the feet, and it is so held in the handles that it rotates in them without any appreciable resistance.

By the aid of this appliance the art of Skipping is so easily acquired and the exertion involved by it can be so readily regulated, that even very old birds† may learn to hop without difficulty, and will soon discover what an invigorating exercise Skipping is.

The GIRBOLA, as adapted for use by adults, may be obtained from the Sanitary & Œconomic Association, Ltd. (Appliances Department), Gloucester. Price 2/6, or post free for 2/10.

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Exercises with the Girbola.

There are four simple movements with which the novice in Skipping may begin to practice :

1. *The Forward Step* (Right). The Girbola is whirled over the head and the right foot lifted, followed by the left, and so on.

* Adapted from the Greek: *guros* a circle, and *bolé* a throw or cast. Compare *gyroscope* and *parabola*.

† Amongst the many applications received for the Girbola are two from gentlemen each over 80 years of age, who desired to try it; and others from less aged veterans of both sexes.

2. *The Backward Step.* In this movement the whirling is reversed.

3. *The Forward Step* (Left). Here the left foot is lifted first, instead of the right, a difficult movement for most people, who are often as much right-footed as they are right-handed.

4. *The Alternate Step.* In this movement the Girbola is whirled forwards, as in 1 and 3, but at each whirl the right and left feet are lifted first alternately.

The acquisition of proficiency in these four movements will be as much exercise as most persons will care for. Those who are more enthusiastic may proceed to doubling and trebling, in which the Girbola is whirled respectively twice and thrice for each jump.

As much of the facility with which the use of the Girbola can be acquired depends on it being of a proper length, it is supplied in a length which is suitable for a fairly tall person. But it can be temporarily shortened by drawing the ends of the cord, to an equal extent, through the rubber rings at each end, which allow of its being lengthened again, if required. Or, the superfluous ends may be cut off, if not wanted.

In skipping the hands should be held so that the handles of the Girbola are horizontal and point outward.

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